

In the United States Court of Federal Claims

No. 18-1894L

Filed: May 2, 2023

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ELIZABETH ORR, et al.,

Plaintiffs,

v.

UNITED STATES,

Defendant.

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Brian K. Matise, Burg Simpson Eldredge Hersh & Jardine, P.C., Englewood, CO for plaintiffs. With him were **Nelson Boyle** and **Emily Lubarsky Quinn**, Burg Simpson Eldredge Hersh & Jardine, P.C., Englewood, CO.

Brian R. Herman, Trial Attorney, Environment and Natural Resources Division, Natural Resources Section, United States Department of Justice, Washington, DC, for defendant. With him were **Zachary T. West**, and **Frank J. Singer**, Trial Attorneys, Environment and Natural Resources Division, Natural Resources Section, **Jean E. Williams**, Deputy Assistant Attorney General, Environment & Natural Resources Division, Natural Resources Section; and **Todd S. Kim**, Assistant Attorney General, Environment & Natural Resources Division. **Bryan Wilson**, Attorney-Advisor, Office of the Field Solicitor, United States Department of the Interior, Billings, MT, of counsel.

OPINION

HORN, J.

Plaintiffs Elizabeth Orr, Howard Carman, and Lena Carman timely filed a complaint in which they assert “claims for taking of their real and personal property entitling them to just compensation under the Fifth Amendment to the United States Constitution” against the United States. During the month of September 2013, all plaintiffs were owners of real property in Larimer County, Colorado, on the Big Thompson River and within the Big Thompson River Canyon. Plaintiffs’ properties were located downstream of Olympus Dam, which is in Estes Park, Colorado and which is operated by the East Colorado Area Office of the United States Bureau of Reclamation, an agency of the United States Department of the Interior. Olympus Dam impounds Lake Estes and, as part of the Bureau of Reclamation’s Colorado-Big Thompson River (C-BT) Project, Olympus Dam releases water from Lake Estes downstream into the Big Thompson River through five radial gates located on a spillway.

Between approximately September 9 and September 16, 2013, area around Estes Park, Colorado experienced heavy rainfall and consequential flooding. Plaintiffs allege that the Bureau of Reclamation's operation of Olympus Dam during the September 2013 storm resulted in the plaintiffs losing "substantially all of their homes, the business owned by the Carmans, and their personal property," as well as "large sections of the land and riverfront property owned by Plaintiffs," which was "displaced or permanently removed when it was washed away in the floodwaters released by the Bureau of Reclamation."

Plaintiffs' complaint alleges that "Defendant, through its agents and employees at the Bureau of Reclamation, made a conscious decision to release water from the Olympus Dam in such quantity as to create a probability, if not a certainty, that Plaintiffs' real property, homes, business, and personal property would be destroyed." Plaintiffs further state in their complaint that defendant's decision to increase releases from Olympus Dam was "due to its concern for the integrity of the dam and the greater public good in preserving the dam and preventing the possible loss of lives if the dam broke versus Plaintiffs' property." Moreover, plaintiffs argue that damage to plaintiffs' property "would not have occurred but for the Defendant's actions," and that the damage was the "foreseeable result of the Defendant's actions, including the Defendant's intentional discharge of water from the dam." Plaintiffs claim entitlement to "the fair market value of their property that was taken, the fair value of the time they were dispossessed from their property, the actual cost to repair and replace the property that can be repaired and replaced; the fair lost market value in their properties due to the flooding," as well as "pre and post-judgment interest as allowed by law," plaintiffs' "reasonable costs, litigation expenses, and attorney and witness fees," "all other damages and compensation to which they [plaintiffs] are legally entitled," and "such other and further relief as equity and justice may allow or require." (alterations added). Plaintiffs' complaint asserts one cause of action, "**Inverse Condemnation**," in which plaintiffs include the claims of Ms. Orr, Mr. Carman, and Mrs. Carman. (capitalization and emphasis in original).

In response to plaintiffs' complaint, defendant filed a motion to dismiss plaintiffs' complaint pursuant to Rule 12(b)(6) (2018) of the Rules of the Court of Federal Claims. After briefing, the court denied defendant's motion to dismiss on the ground that "discovery is necessary to determine whether plaintiffs' allegations demonstrate a taking, and, therefore, plaintiffs should be given the opportunity to develop facts in support of their claims." Orr v. United States, 145 Fed. Cl. 140, 158 (2019). Following the denial of defendant's motion to dismiss, the parties conducted extensive discovery proceedings. After the close of discovery, the court held a trial lasting nine days. After reviewing the exhibits entered into the record and the testimony offered by the witnesses at trial, among whom were the three plaintiffs, the court makes the following findings of fact.

FINDINGS OF FACT

Olympus Dam and Lake Estes, which Olympus Dam impounds,¹ are located on the Big Thompson River in Estes Park, Colorado. The United States Bureau of Reclamation owns and operates Olympus Dam as part of the Bureau of Reclamation's C-BT Project, which the parties stipulated "is a water diversion and storage project that brings water from the west slope of the continental divide to the east slope, for agricultural, municipal, industrial, and hydroelectric generation purposes." The parties further stipulated that the C-BT Project serves, without limitation, two purposes: "(1) transferring water from Colorado's Western Slope to its Eastern Slope for use by the Northern Colorado Water Conservancy District ('NCWCD') [Northern Water]; and (2) the generation of electricity marketed by the Western Area Power Administration ('WAPA')." ² (alteration added).

According to a Senate Report, dated June 15, 1937, titled "Synopsis of Report on Colorado-Big Thompson Project, Plan of Development and Cost Estimate Prepared by the Bureau of Reclamation, Department of the Interior," (capitalization in original), the C-BT Project has five purposes:

1. To preserve the vest and future rights in irrigation.
2. To preserve the fishing and recreational facilities and the scenic attractions of Grand Lake, the Colorado River, and the Rocky Mountain National Park.
3. To preserve the present surface elevations of the water in Grand Lake and to prevent a variation in these elevations greater than their normal fluctuation.
4. To so conserve and make use of these waters for irrigation, power, industrial development, and other purposes, as to create the greatest benefits.
5. To maintain conditions of river flow for the benefit of domestic and sanitary uses of this water.

The record before the court includes the Standard Operating Procedures of Olympus Dam, Estes Powerplant, and Lake Estes, dated April 2005, which were in effect at the time of the September 2013 storm. The Standard Operating Procedures provide, under the heading "**PURPOSE OF THE PROJECT**," in relevant part: "The primary purpose of the Project is to provide supplementary water to 720,000 acres of irrigated

¹ Witnesses at trial consistently testified that Olympus Dam "impounds" the Lake Estes reservoir, and the parties also use that term in their briefs.

² Tim Miller, a hydrologist for the Bureau of Reclamation, described in his testimony that the WAPA is a hydropower wholesaler which markets to customers the power generated by the Bureau's C-BT facilities.

land in northeast Colorado. The secondary purpose is to utilize the power potential of the water as it drops 2,800 feet between the Alva B. Adams Tunnel and the foothills storage system.” (capitalization and emphasis in original).

Upstream of Olympus Dam in the C-BT Project is the Adams Tunnel, which the parties stipulated “brings water from the C-BT’s west slope facilities” through the mountains of the continental divide “to the east slope, depositing water in the East Portal Reservoir.” The maximum flow of Adams Tunnel is 550 cubic feet per second (cfs).³ According to the testimony of Carlos Lora, a hydrologic engineer and water scheduler in the Water Resources Group of the East Colorado Area Office of the Bureau of Reclamation, United States Department of the Interior, the flow of Adams Tunnel is measured at the East Portal Reservoir. According to the testimony of James VanShaar, who was the head of the Water Resources Group in the East Colorado Area Office of the Bureau of Reclamation, United States Department of the Interior, during the September 2013 storm, once the water from Adams Tunnel is deposited in the East Portal Reservoir, “[a]lmost all of it goes into the Marys Lake Powerplant,” which has a capacity of approximately eight megawatts. (alteration added). From Marys Lake Powerplant, water passes into Marys Lake and through the Estes Powerplant. Estes Powerplant has a capacity of 45 megawatts, divided between three 15-megawatt units. The water leaving Estes Powerplant then flows into Lake Estes alongside the Big Thompson River.

Olympus Dam impounds Lake Estes. The parties stipulated that water comes into the Lake Estes reservoir through “the Estes Power Plant, the Big Thompson River above Lake Estes, Fish Creek, other smaller creeks and natural inflows, and rainfall over the reservoir.” The parties further stipulated that water leaves the Lake Estes reservoir “(1) through one or more of the five spillway gates into the Big Thompson River; (2) through a small slide gate into the Big Thompson River; and (3) through the Olympus Tunnel.” Water that leaves Lake Estes through the spillway gates or the slide gate of Olympus Dam enters the Big Thompson River, in the Big Thompson River Canyon, “below” or downstream from Olympus Dam. Water that leaves Lake Estes through the Olympus Tunnel enters another portion of the C-BT Project but, as the parties stipulated, may “re-enter the Big Thompson River near the mouth of the Big Thompson River Canyon,” downstream of plaintiffs’ properties. According to the parties’ stipulations, “[i]n most normal operating circumstances, and absent appropriate state authorization, natural runoff into the C-BT is not project water” belonging to the Bureau of Reclamation, and, therefore, “the majority of water in Lake Estes is C-BT water.” (alteration added).

According to the parties’ joint stipulations, water that passes through Olympus Dam flows into the Big Thompson River, and joins a tributary downstream, the North Fork Big Thompson River at the confluence at Drake, Colorado, within the Big Thompson River Canyon. According to the testimony of James VanShaar and a diagram of the C-BT Project admitted as a joint exhibit at trial, when the Big Thompson River reaches the mouth of the Big Thompson River Canyon, a portion of the water passes through the City of Loveland Powerplant, also identified as the Idylwilde Powerplant, before rejoining the

³ Two abbreviations of “cubic feet per second” appear throughout this Opinion, “cfs” and “ft³/s.” The abbreviations “ft³/s” or “ft³” (cubic feet) appear only in quotations.

Big Thompson River immediately thereafter. Downstream of the Idylwilde Powerplant, a portion of the water in the Big Thompson River is diverted through the Big Thompson Tunnel and the Dille Diversion Dam to flow through the Big Thompson Powerplant, while the majority of the water continues to flow in the Big Thompson River. Mr. VanShaar testified that the Big Thompson River is typically “a very small river, barely more than what they would call a creek in other parts of the country,” with an average flow of between 50 and 75 cfs, and shallow enough that, in most places, “you could walk across it.”

According to the testimony of Anthony Curtis, chief of the Resource Division at the East Colorado Area Office of the Bureau of Reclamation, United States Department of the Interior, the majority of the water in facilities in the Eastern Slope portion of the C-BT comes from the Western Slope via the Adams Tunnel, and rights to most of that water are held by Northern Water. In the Eastern Slope facilities of the C-BT Project, water travels downstream in the direction of what Mr. Curtis described as the “terminus reservoirs” of Carter Lake and Horsetooth Reservoir, from which reservoirs it is delivered to the constituents of the project.

Water that leaves Lake Estes through the Olympus Tunnel typically travels through the Bureau of Reclamation’s Pole Hill Powerplant. The Pole Hill Powerplant has a capacity of 35 megawatts. In the event that the Pole Hill Powerplant is taken offline, the Bureau can redivert water through a Rediversion Structure in Little Hells Canyon, Colorado. According to the testimony of Mr. VanShaar, water that is rediverted through Little Hells Canyon enters the North Fork of the Little Thompson River and then the Rattlesnake Canal and Tunnel. Mr. VanShaar also testified that “some small amount less than 550 cfs can be rediverted at the rediversion structure.” According to the testimony of Ralph Beall, facility manager of the C-BT Project at the Bureau of Reclamation, United States Department of the Interior, the Rediversion Structure is “made out of timbers, perhaps six-inch by six-inch, and they [the water] go through some gates that go into the afterbay of Pole Hill.” (alteration added). Water which is not rediverted away from the Pole Hill Powerplant travels through the Pole Hill Powerplant and into the Pole Hill afterbay, which, according to the testimony of Mr. Beall, “has a very small levee, to push that water through the siphon into Pinewood Reservoir.” Mr. VanShaar indicated that whether the water passes through the Pole Hill Powerplant or is rediverted through Little Hells Canyon, however, the water ultimately flows into the Pinewood Reservoir and the Flatiron Powerplant. The Flatiron Powerplant has three generators, two with 45-megawatt capacities, and one with a ten-megawatt capacity. Some of the water which passes through the Flatiron Powerplant is diverted to Carter Lake, one of the C-BT’s two terminal reservoirs, while the remainder of the water continues flowing into the Charles Hansen Feeder Canal. The Charles Hansen Feeder Canal carries water to the Big Thompson Powerplant at the mouth of the Big Thompson River Canyon or to the Horsetooth Reservoir, according to the testimony of Mr. Beall and Mr. VanShaar.

According to Mr. VanShaar, most of the water in the C-BT Project ultimately passes through a three-flow system known as the Trifurcation at the mouth of the Big Thompson River Canyon. The water which re-enters the Big Thompson River continues flowing south as far as Boulder, Colorado. The Trifurcation was described by Mr. Beall as “different ways that we [the Bureau] can move water through Big Thompson Powerplant”

after passing through the rest of the upstream C-BT system. (alteration added). First, Mr. Beall testified, water which is not sent through the Olympus Tunnel, but stays in the Big Thompson River is skimmed⁴ “at a diversion called Dille Tunnel, which is at the Narrows a couple miles upstream of the power plant,” and from there the water flows into the 930 Section of the Charles Hansen Feeder Canal and on to the Big Thompson Powerplant. Second, according to Mr. Beall, water may pass through the Olympus Tunnel and the Pole Hill Powerplant, Pinewood Reservoir and Flatiron Powerplant, Carter Lake and then into the 930 Section of the Charles Hansen Feeder Canal, which leads to the Big Thompson Powerplant. Third, water in the 930 Section, rather than flowing into the Big Thompson Powerplant, can instead flow north into another section of the Charles Hansen Feeder Canal, the 550 Section, and from there flow into Horsetooth Reservoir, according to Mr. Beall’s testimony.

The parties stipulated that Olympus Dam is composed of “an earthen embankment portion [of the dam], with crest elevation 7,481 feet above sea level, and a concrete gravity dam featuring a spillway.” (alteration added). Through five release gates in the concrete gravity dam, also referred to interchangeably as “radial gates” and “spillway gates,” the Bureau of Reclamation can release water from Lake Estes into the Big Thompson River. Mr. VanShaar testified that the spillway release gates raise vertically to release water onto the spillway. The parties stipulated that when closed, “[t]he top of the spillway gates is elevation 7,475 feet above sea level.” (alteration added). At trial, Adam Northrup, an engineering technician with the Bureau of Reclamation, United States Department of the Interior, testified regarding the operation of the spillway gates, “there’s a cable that’s connected to the bottom of the radial gates,” which is connected to mechanisms, called trunnions, on the outside, or downstream side, of the gates, “and the trunnions are the hinge, and the cable pulls up from the bottom of the gate and there’s a motor on the cable to reel it in,” and by reeling the cable in, the mechanism opens the gate.

The parties stipulated that the spillway of Olympus Dam has a “design capacity” of 21,200 cfs. Of the five spillway release gates, the Bureau of Reclamation office at Casper Control Center in Wyoming can operate one gate remotely, “up to a maximum release of approximately 900cfs.” According to the testimony of Mr. Beall, Gate 3, the middle gate, is the release gate which is typically operated remotely. According to the parties’ joint stipulations and the Post Incident Analysis Report on the September 2013 flood prepared by the Bureau of Reclamation (the Post Incident Analysis Report),⁵ a dam operator must be present at the dam in order to open the remotely operated gate further than a release of 900 cfs, or to open any of the four gates which are not remotely operated.

Olympus Dam is classified by the Bureau of Reclamation as a “high hazard dam,” which the parties stipulated that the Bureau of Reclamation defines “as one in which more than six lives would be in jeopardy and excessive economic loss would occur as a direct

⁴ At trial, Mr. Miller testified that “skimming” water means to borrow water from the river for use in generating hydropower and returning the water to the river within 24 hours.

⁵ The Post Incident Analysis Report on the September 2013 flood was jointly submitted by the parties as an exhibit and is dated October 2014.

result of dam failure.” According to the testimony of Mr. Northrup, in the event that the water in Lake Estes overtopped Olympus Dam, water would overtop the spillway gates first, which are lower than the earthen portion. According to the testimony of Mr. Beall, Olympus Dam is “an important link in the [C-BT] system.” (alteration added). Olympus Dam’s importance is due in large part to the fact that, absent Olympus Dam, the Bureau of Reclamation could not divert water through the Olympus Tunnel towards the Pole Hill and Flatiron powerplants. Mr. Beall explained that Olympus Dam is also necessary to the functioning of the facilities down the Olympus Tunnel because Olympus Dam, by impounding Lake Estes, creates the “head,” or difference in water elevation, necessary to drive water through the Olympus Tunnel and into the Pole Hill Powerplant and other downstream powerplants on that branch of the C-BT Project.

The Standard Operating Procedures for Olympus Dam describe the dam as follows:

The dam is a 1,951-foot-long composite structure, consisting of a zoned earth embankment with slopes of 3:1 H:V⁶ upstream and 2:1 H:V downstream, and a concrete gravity dam containing a spillway overflow section. The upstream face of the earth embankment is protected by a layer of riprap and the downstream face is protected by a layer of rock and cobble fill.

(footnote added). Further, according to the Standard Operating Procedures:

The maximum structural height of the concrete gravity dam is 70 feet, at the contact with the earth embankment. The structural height of the embankment section is 70 feet with a crest width of 30 feet. The concrete portion of the dam has a crest width of 10.5 feet including the overhang of the parapet and curb, and a maximum base width of approximately 60 feet, not including the spillway apron. Construction of Olympus Dam was completed in 1949.

The parties stipulated that “Olympus Dam is not a flood control dam,” meaning that the Lake Estes reservoir has a relatively small capacity: in the “operational range” of the reservoir, between 7,469.5⁷ feet elevation and 7,474 feet elevation, “Lake Estes can store 740 acre-feet of water,” and the entire capacity of Lake Estes up to 7,474 feet elevation

⁶ Neither the Standard Operating Procedures nor the witnesses at trial defined “H:V” as used in the Standard Operating Procedures.

⁷ While 7,469.5 feet in elevation is referred to as the bottom of the operational pool, according to the Standard Operating Procedures, “[n]ormally, the reservoir is maintained between elevations 7471 and 7475 for recreation,” which according to the testimony of Mr. VanShaar refers to the water level necessary for activities like boating and fishing. (alteration added).

is 3,069 acre-feet.⁸ With respect to the storage capacity of the reservoir, the Standard Operating Procedures for Olympus Dam refer to the elevation range between 7,450.25 feet and 7,475 feet as “Active Conservation Storage,” while the elevation range between 7,474 feet and 7,475 feet is labeled “Regulatory Reserve,” which the Standard Operating Procedures explain as “a sub pool within the active conservation storage containing water immediately below the spillway but above the normal water surface used for power generation, which should be used only in emergency situations.” Paula O’Brien, who at the time of the September 2013 flood was known as Paula Baty and who worked as a dam safety engineer at the East Colorado Area Office of the Bureau of Reclamation, United States Department of the Interior, testified that “there are a number of implications” to the fact that Olympus Dam is not a flood control dam, “the most important” of those implications being that “neither its outlets nor its size is designed to manage flood flows.”

The Standard Operating Procedures for Olympus Dam require the keeping of an Operating Log, and state, under the heading “**CERTIFICATION OF STANDING OPERATING PROCEDURES REVIEW BY OPERATING PERSONNEL:**” “All operating personnel will certify the above and sign the Operating Log.” (capitalization and emphasis in original). The Standard Operating Procedures further state, under the heading “**G. OPERATING LOG:**”

The purpose of the Operating Log is to have a chronological record of all important events to provide a continuing record of operating activities, and to provide clues to the possible cause of equipment trouble or the development of unusual conditions occurring at the dam.

The Operating Log shall be kept in the control house in a bound book. A sample of an Operating Log (Form 7-1623) is shown in appendix B-2. All entries shall be in ink or other indelible material. Corrections in the logbook shall be made by crossing out the incorrect notation so that it is still legible, and adding the correct entry. Do not erase or eradicate entries in the logbook.

A logged record shall be maintained by the operating personnel or designated alternate on duty. Portions of the information will be available from automatic recordings and monitoring equipment. Specific data may vary in form and content to fit the needs and conditions present at the dam. In general, the data shall include information such as:

- Normal and emergency changes in operation of outlet works and/or spillways including individual gate changes and positions.
- Water elevations and discharges.
- Startup and stopping of mechanical equipment.
- Testing of standby equipment or gate controls.

⁸ The elevation of 7,474 feet also was referred to by Mr. Lora as the top of the “operational pool” and by Mr. VanShaar as the top of the “regulatory pool.”

- Minor and major maintenance activities including scheduled maintenance.
- Reservoir surveillance.
- Initial acknowledgement of unusual or emergency conditions.
- Requests and concurrence to change from normal operation during unusual or emergency conditions.
- Exercising of all gates and valves.
- Communications network checks.
- Record of names and address of official visitors and all Reclamation review teams.
- Reports on acts of vandalism.
- Certification of SOP [Standard Operating Procedures] review by Dam Operator and supervisor.
- Record of Comprehensive/Periodic Facility Review and annual examinations.
- Certification and type of Dam Operator's training.
- Miscellaneous items pertinent to operation and emergency or unusual incidents at the structures.
- Record of performance of "Ongoing Visual Inspections."

Some other approved record forms are included in Appendix B. These records are also considered part of the dam operator's Operating Log, and shall be accessible at all times.

The Operating Log is kept in the control house at Olympus Dam.

(capitalization and emphasis in original; alteration added). According to the testimony of Mr. VanShaar, the Operating Log for Olympus Dam was kept at Casper Control Center in Wyoming by Bureau personnel, and contained entries not only for Olympus Dam, but also for Lake Estes and other relevant C-BT Project facilities.

Moreover, the Bureau of Reclamation's Standard Operating Procedures, as included in the record before the court, provide for an Emergency Action Plan, which is dated May 2003 in the version included in the record before the court. The parties stipulated that, pursuant to the Standard Operating Procedures and the Emergency Action Plan, the Eastern Colorado Area Office designates an Incident Management Team⁹ in emergency situations. According to the parties' stipulations, the "IMT [Incident Management Team] includes employees from various components of the ECAO [East Colorado Area Office]" and "is responsible for managing the ECAO's response to the event." (alterations added). According to the parties' joint stipulations, "in the beginning

⁹ In his testimony at trial, water scheduler Mr. Miller referred to an "Incident Command Team," which was tasked primarily with communication with the media, whereas the Incident Management Team was concerned with coordinating "the different emergency responders for the different cities and the sheriff's offices and things like that," as well as declare Response Levels.

of the September 2013 storm,” the East Colorado Area Office formed an Incident Management Team, and Ralph Beall was designated the “Incident Commander” of the Incident Management Team. The Post Incident Analysis Report prepared by the Bureau of Reclamation explains:

The Colorado Big Thompson Facility Manager, Ralph Beal [sic], was the Incident Commander as delegated by the ECAO [East Colorado Area Office] Area Manager, Michael Collins (Agency Administrator). An Incident Management Team (IMT) concept was used which helped facilitate better span of control, chain of command, resource management, facilitate awareness of project operations and maintain situational awareness. ECAO had adopted Incident Command Systems (ICS) for incident management across its projects and has conducted ICS training and incorporated these concepts into their EAPs [Emergency Action Plans].

The ECAO Incident Commander has the authority to declare an emergency at Olympus Dam and activate the IMT. The ECAO ICS organizational structure for this event is shown in the figure below.

(alterations added).

The Post Incident Analysis Report indicates that, alongside Mr. Beall, the Incident Management Team consisted of the Liaison Officer, Jacklynn Gould, the Safety Officer, David Hartman, the Security Officer, Howard Bailey, the Agency Representatives to the City of Loveland Emergency Operations Center, James VanShaar and Andrew Gillmore, and the Public Information Officer, Kara Lamb, although the Post Incident Analysis Report does not specify at what times the members joined the Incident Management Team. Paula O’Brien, who, as noted above, was at the time serving as safety engineer in the East Colorado Area Office, testified at trial that she also joined the Incident Management Team sometime the morning of September 12, 2013. The Post Incident Analysis Report indicates that the Incident Management Team reported to the Agency Administrators for the East Colorado Area Office, identified as the Manager, Michael Collins, and the Deputy Manager, Jacklynn Gould, who, as noted above, also served as the Liaison Officer. At trial, Mr. Beall testified that, despite holding the title “Incident Commander,” he was not the “lead decision-maker,” and Mr. Beall identified three individuals who outranked him: Michael Collins and Jacklynn Gould, who Mr. Beall identified as “my boss’ boss and boss,” and Charles Pedersen, who Mr. Beall identified as “my direct boss” and who the Post Incident Analysis Report identifies as head of the Operations Section.¹⁰ Mr. Beall further testified that, when holding the title of Incident Commander, he remained “the facility manager at the same time.” Mr. Beall described the decision-making process for the Incident Management Team:

So the incident command team would meet. Water scheduling is watching and monitoring the precipitation event. They come in with data. We

¹⁰ At trial, Mr. Northrup identified Mr. Pedersen as the “chief of Operating and Maintenance Division” at the time of the September 2013 flood.

collectively meet as a group, whether it's by phone or in person. We assess the situation and what is occurring right at that moment.

Then we look at the Emergency Action Plan to see if we need to go to an alert level, and then we pass on that information. And in my case, I'd be passing on information to my subordinates on infrastructure planning, making sure we're ready for whatever the situation might be, and then there's a contact string where, for instance, the Great Plains duty officer needs to be contacted, public information officer may need to outreach to people. So that's kind of how the meeting would go.

And then we would agree on an alert level and what possible changes could make us have to meet again, and agree on responsibilities throughout the organization.

Mr. Beall further explained:

Then my plan was to pass that information on to my foreman and then ultimately on to the staff to be ready to act as needed, and then there is a list of contacts that need to be made as you go through your alert levels, starting with internal alert, Level 1, Level 2, Level 3, et cetera.

Our security officer, Howard Bailey, and emergency management man, at the very first meeting, he volunteered to make those notifications throughout our process and then confirmed with me after he had done that.

Mr. Beall also testified that "[a]lways when you have a situation, you start with your Emergency Action Plan," which Mr. Beall indicated was Bureau of Reclamation policy. (alteration added). While the Post Incident Analysis Report stated that the "Incident Commander, has the authority to declare an emergency at Olympus Dam and activate the IMT," (alteration added), Mr. Beall testified that he did not "recall independently having the authority to declare an emergency at Olympus Dam," but rather stated that "we [the Incident Management Team] start by meeting, using our collective knowledge and experience, and going through our documents and agreeing on what actions we're going to take." (alteration added). According to the Post Incident Analysis Report prepared by the Bureau, which was corroborated by the testimony of Mr. Beall and Mr. Miller, Mr. Bailey was responsible for public notifications from the Incident Management Team, as follows:

Official notification of dam Response Levels and project operations including operational releases from Olympus dam were made by the ECAO Emergency Management Coordinator (Howard Bailey). Public information was coordinated directly with the public and the media by the ECAO Public Information Officer (PIO) (Kara Lamb). The official notification process was followed in accordance with the EAP [Emergency Action Plan] and Reclamation policy. The ECAO made Response Level notifications to the

Great Plains Region Duty Officer (GPRDO) in a timely fashion and provided sound information on incident details.

(alteration added).

According to Mr. Beall's testimony, "the Incident Management Team met on a regular basis during the [September 2013] storm event." (alteration added). According to the testimony of Mr. Miller, the Incident Management Team functioned mainly to pass on information and that the water schedulers, whose function was to make decisions regarding releasing water into the river. Ms. O'Brien testified that, in her role in the Incident Management Team, she "would relay information and requests about monitoring and what we needed to do and critical information about the engineering or structure of the facility" to Mr. Beall, and "let him know what resources we would need and when -- when we might need to do different things" with the operation of Olympus Dam.

The Emergency Action Plan for Olympus Dam, as included in the record before the court and in effect during the September 2013 storm, provides for five levels of emergency response, which range from "Internal Alert," the least severe response level, to Response Level 4, the most severe response level, indicating failure of Olympus Dam. In relevant part, the Internal Alert response level is defined by the Emergency Action Plan:

1. The Internal Alert Response Level is the least serious of the Response Levels. Declaration of the Internal Alert Response Level means that an "Internal Alert" will be conducted in which emergency response activities including internal notifications for affected organizations will be carried out.
2. This means that these organizations will observe and analyze the event, and that they will "stand-by" because nothing "serious" is happening yet. But indications are that something definitely IS happening that could develop into a potentially significant threatening event only if it intensifies.

(capitalization and emphasis in original). Response Level 1 is defined in relevant part:

1. Declaration of Response Level 1 means that involved organizations need to "Standby" for additional information relative to developing conditions. Nothing significant really needs to be done for Response Level 1 except to stay aware of the event after it is detected, and observe and analyze it for possible action. Nothing significant has developed yet, but indications are that something definitely IS happening that could progress into a potentially significant threatening event if it continues or intensifies.
2. Local emergency management officials of jurisdictions downstream will receive, and be encouraged to conduct, a "communications check" during Response Level 1 to allow their response organizations to go into alert status. Response agencies generally do not mobilize resources for declaration of Response Level 1.

3. Response Level 1 does NOT represent an emergency YET, but may be perceived as such by the media or general public. Nor does Response Level 1 pose a hazard, either at the dam or to downstream populations at risk, at the time of observation.

(capitalization and emphasis in original). The definition of Response Level 1 also provides: “Any developing events that belong in Response Level 1 will be identified as being of a level of intensity where they can be managed and brought under control by the dam operating personnel with NO NEGATIVE IMPACTS DOWNSTREAM.” (capitalization in original).

Response Level 2 is defined in relevant part:

1. Declaration of Response Level 2 means that conditions are now more serious than those in Response Level 1 but not yet serious enough to declare Response Level 3.

2. For this Response Level, the dam will not have failed, nor is failure imminent. However, the condition of the structure will currently be unstable, or operational releases will be such that they may become life-threatening. This means that the dam may yet be stabilized, or that operational releases may not actually impact populations at risk if conditions diminish in intensity or are brought under control, but circumstances are such that populations at risk MUST BE placed on “stand-by” status which means notifications to populations at risk should include directions to BEGIN PREPARATIONS to leave predetermined inundation areas for higher ground and safe shelter. It also means that conditions COULD worsen that WOULD require an evacuation if not brought under control effectively.

3. Upon notification of declaration of Response Level 2, local emergency management officials and response agencies will be encouraged to mobilize resources and position them at staging areas. For flood operations, initiate road access closures and begin staging evacuation of low areas as flood releases are staged up.

(capitalization in original). The definition of Response Level 2 further provides: “Notification to designated downstream 24-hour warning points is a REQUIRED ACTION THAT WILL BE TAKEN whenever Response Level 2 is declared.” (capitalization in original).

Response Level 3 is defined in relevant part:

1. Declaration of Response Level 3 means involved organizations must “GO” (initiate evacuation). Declaration and implementation of Response Level 3 means the situation is extremely serious. For this Response Level, major life-threatening operational releases will be made, major structural damage to the dam will occur, or the physical condition of the dam will have

deteriorated such that stabilization is not possible and the dam will most likely fail.

2. For this Response Level, one, or more, of the following emergency conditions will be present:

a. OPERATIONAL RELEASES HAVE BECOME LIFE-THREATENING.

b. THE DAM IS IN DANGER OF IMPENDING FAILURE.

3. Declaration of this Response Level means populations at risk are in IMMEDIATE DANGER and that evacuation of populations at risk in all or a portion of the dam failure flood inundation area is REQUIRED!

(capitalization in original). The definition of Response Level 3 further provides:

5. Response Level 3 will be declared and initiated for all situations ANYTIME that it becomes obvious, through analysis of threatening events, that IMMEDIATE EVACUATION of populations at risk located downstream from the affected dam is necessary! Again, notification to the downstream 24-hour Warning Point(s) is a REQUIRED ACTION THAT WILL BE TAKEN whenever Response Level 3 is declared.

6. Declaration of Response Level 3 will be based on the certainty that LIFE-THREATENING floodwaters will affect populations at risk.

7. In cases where Response Level 3 is declared without passing through an Internal Alert or Response Levels 1 and/or 2 first, carrying out expected actions for Response Level 3 is the first priority. Expected actions for the Internal Alert or Response Levels 1 and 2 will be checked and completed only after having completed them for Response Level 3 first.

8. A protective action recommendation will be made that local authorities issue an [sic] public evacuation warning to immediately leave flood inundation areas for safe areas.

9. Local authorities are responsible for advising the public on safe evacuation routes and where to go for safe shelter. Response organizations will be encouraged to fully mobilize and physically implement evacuation procedures for Response Level 3.

(capitalization in original).

Response Level 4 is defined in relevant part:

1. Declaration of Response Level 4 means the dam is "GONE" (it has failed). This is the most dangerous Response Level.

2. For this Response Level, the following emergency conditions will be present:

a. THE DAM IS FAILING/THE DAM HAS FAILED.

b. RESULTANT RELEASES ARE EXTREMELY LIFE-THREATENING.

3. Declaration of this Response Level means populations at risk and response personnel conducting evacuations in inundation areas are in IMMINENT DANGER and that they should leave the dam failure flood inundation area IMMEDIATELY!

(capitalization and emphasis in original).

The Emergency Action Plan provides a set of “Initiating Conditions” for each of the emergency response levels. Under the heading “Decision-Making,” the Emergency Action Plan provides, in relevant part:

The decision will be made by the Area Office to declare a specific response level based on an analysis of identified initiating conditions for Olympus Dam. For hydrologic events, the decision will be made by the Area Office based on the April 1996 Olympus Dam Early Warning System Decision Criteria Document. The dam operator will only declare a Response Level in the event communications between the dam and the Area Office is interrupted or the initiating conditions require going immediately to a Level 3 Response.

The Emergency Action Plan categorizes initiating conditions for all response levels except for Response Level 4 as either “HYDROLOGIC EVENTS,” “EARTHQUAKE,” or “ALL OTHER EVENTS.” (capitalization in original).

The Emergency Action Plan provides the following initiating condition for an Internal Alert response level with respect to hydrologic conditions: “It becomes evident, based on rainfall and streamflow data being received from the EWS [Early Warning System] basin-monitoring equipment, that releases of 1,000 ft³/s will need to be made from the dam.” (alteration added). The Emergency Action Plan provides the following two initiating conditions for Response Level 1 with respect to hydrologic conditions:

a. A Flash Flood **Watch**, Flood **Watch**, or Severe Storm **Watch** is issued by the National Weather Service for the Estes Park area or the Olympus Dam Drainage Basin.

b. It becomes evident, based on rainfall and streamflow data being received from the EWS basin-monitoring equipment, that releases of 1,100 ft³/s will need to be made from the dam. An existing agreement requires Reclamation to contact the City of Loveland when a release of 1,100 ft³/s will be made.

(capitalization and emphasis in original).

The Emergency Action Plan provides the following four initiating conditions for Response Level 2 with respect to hydrologic events:

- a. A Flash Flood **Warning**, Flood **Warning**, or Severe Storm **Warning** is issued by the National Weather Service for the Estes Park area or the Olympus Dam Drainage Basin.
- b. It becomes evident, based on rainfall and streamflow data being received from the EWS basin-monitoring equipment, that releases of 1,500 ft³/s will need to be made from the dam. It is at a flow of 1,500 ft³/s in the Big Thompson River that water level first reaches the level of homes and businesses below Olympus Dam.
- c. Rainfall totals greater than 1.2 inches in 1 hour or 1.7 inches in 3 hours at half of the operating rain gauges. Refer to the April 1996 Olympus Dam EWS Decision Criteria Document.
- d. It becomes evident, based on rainfall and streamflow data being received from the EWS basin-monitoring equipment, that inflows to Lake Estes will reach 5,000 ft³/s. It is estimated that the Olympus Dam spillway will be plugging at inflow of about 5,000 ft³/s.

(capitalization and emphasis in original).

The Emergency Action Plan provides the following two initiating conditions for Response Level 3 with respect to hydrologic events:

- a. It becomes evident, based on rainfall and streamflow data being received from the EWS basin-monitoring equipment, that releases of 1,500 ft³/s will need to be made from the dam. As mentioned earlier, it is at a flow of 1,500 ft³/s in the Big Thompson River that water level first reaches the level of homes and businesses below Olympus Dam. Also, most structures in the Big Thompson Canyon Below Olympus Dam are inundated at a flow of 6,000 ft³/s. Once Response Level 3 has been declared, continual contact will need to be established between Reclamation and downstream authorities so that evacuation of downstream populations can be coordinated with anticipated releases from the Dam.
- b. Rainfall totals greater than 1.5 inches in 1 hour or 2.2 inches in 3 hours at half of the operating rain gauges. Refer to the April 1996 Olympus Dam EWS Decision.

(capitalization and emphasis in original). The Emergency Action Plan provides only one initiating condition for Response Level 4, without categorization: "Olympus Dam begins to fail, or has failed, from any cause."

The Emergency Action Plan further provides tables of “**EXPECTED ACTIONS**” for each of the Response Levels. (capitalization and emphasis in original). The Emergency Action Plan states, under the heading “**EXPECTED ACTIONS TABLES:**”

1. Expected Actions of organizations have been arranged according to the severity and time of occurrence of the developing emergency event and then placed under the appropriate Response Levels. This means that the Expected Actions for each organization will be the response actions that organization will implement when that Response Level is declared. This operating methodology has been designed to help prevent organizations from over or under reacting to the observed and identified emergency event that is occurring.
2. The Expected Actions for each organization under each Response Level listed are presented in columnar format with three columns.
3. Column 1 presents the tasks or responsibilities an agency or individual will need to implement in response to declaration of the Response Level. In all cases, the responsible person (by title) who is responsible to ensure that the listed task and/or responsibility is carried out for each office is as follows:
 - a. **DAM OPERATIONS PERSONNEL:** The Dam Operator and/or the Facility Supervisor, for the Estes/Marys Lake Powerplant.
 - b. **LOVELAND CONTROL CENTER (LCC):** The LCC Operator and/or Foreman.
 - c. **EASTERN COLORADO AREA OFFICE (ECAO):** Water Scheduling/Safety of Dams Staff or Division Chief and/or the Area Manager.
 - d. **GREAT PLAINS REGIONAL OFFICE (GPRO):** Facility Operation Services Group Staff or Group Leader and/or the Infrastructure and Engineering Services Group Manager.
4. Column 2 provides space for personnel to date/time stamp when the listed task/responsibility was completed. This, in effect, becomes the documentation for final reports that must be submitted upon cessation of emergency operations.
5. Column 3 lists “Location of the Implementing Procedure”. [sic] This procedure may be located somewhere in the Emergency Action Plan, Standard Operating Procedures, or in some other procedural document for the organization.
6. The four Response levels shown are sequenced in ascending order of severity for each individual and/or organization.
7. Note: Although Reclamation can coordinate with downstream officials regarding the affect [sic] that Olympus Dam releases may have on downstream flooding caused by inflows below the dam, this EAP and the Olympus Dam EWS are for storm events occurring above the dam and cannot be relied upon by local officials for storm events occurring below the dam.

(capitalization and emphasis in original; alterations added). At trial, Tim Miller testified that “as the water scheduler that day,” meaning September 12, 2013, he “would have followed this portion of the Emergency Action Plan as applicable.”

The Emergency Action Plan further provides for a series of “**HAZARD SPECIFIC GUIDELINES**.” (emphasis and capitalization in original). The “Hazard Specific Guidelines state at the outset:

A. INTRODUCTION

1. All information contained in the following hazard specific guidelines is directed toward actions the dam operating personnel may need to take and data they will need to gather to help facilitate decision-making directed toward ensuring the structural integrity of Olympus Dam and appurtenances for specific incidents that could have an impact on the dam.
2. In all cases, regardless of the incident, the following shall apply:
 - a. The first action taken by the dam operating personnel, or anyone receiving incoming data from the EWS shall be to implement the actions and notification procedures as specified in the Response Levels System for Olympus Dam; and,
 - b. The dam operating personnel will then implement procedures to gather additional data and to preserve the structural integrity of Olympus Dam and appurtenant structures as specified in this Emergency Action Plan for specific events.
3. Information presented in the following guidelines is addressed primarily at making visual observations, taking instrumentation readings, and providing that data to decision-makers in the Eastern Colorado Area Office, and Great Plains Regional Office.

B. REPORT OF EMERGENCY SITUATION OR UNUSUAL OCCURRENCE

1. A record of all telephone or radio reports of emergency situations or unusual occurrences shall be maintained at all steps of the communications network. The form on the following page shall be used in documenting the report. A supply of these forms should be kept on hand and filled out in event of an emergency report or the event should be recorded in the logbook. Each call should be recorded in a chronological order as necessary to maintain continuing records during an incident.
2. This report shall be considered part of the Operating Log and should be accessible at all times.

(capitalization and emphasis in original). The “Hazard Specific Guidelines” within the Emergency Action Plan further provide, under the heading “**C. FLOOD OPERATIONS OR LARGE RELEASES INTO THE DOWNSTREAM CHANNEL:**”

1. Hazard Identification: There is no flood control space allocation in Lake Estes. The hydrologic loading condition, identified as being the most critical inflow scenario for warning purposes, is the Probable Maximum Flood whose peak discharge is 83,900 ft³/s and whose volume is 79,900 acre-feet. It has been estimated that failure of the dam from a flood of this size would result in a peak discharge of 108,000 ft³/s in the Big Thompson River with an average depth of 20 feet.
2. Operating Personnel:
 - a. Flood operating Criteria
 - (1) The dam will be attended 24 hours per day when major inflows occur which may endanger the safety of the dam and/or downstream residents.
 - (2) The status of operations in the drainage area above Estes Power Plant should be established during an emergency. If necessary and conditions permit, dispatch an employee to search for a route from the flood area in order to advise higher authority of the situation and to re-establish communications.
 - (3) When a heavy rainstorm develops in the Rocky Mountain National Park, within the Big Thompson River Drainage Basin, the Chief Ranger of the park will notify the Estes Power Plant Foreman. The Estes Power Plant Foreman will notify the Loveland Control Center (LCC),^[11] who will relay this information to the Water Scheduling Division, Water and Land Operations Division, and Power Division of the Eastern Colorado Area Office (ECAO). ECAO will notify the Estes Park Police Department and Larimer County 24-Hour Warning Point that flooding may occur above and below Lake Estes.
 - (4) **IF OLYMPUS DAM APPEARS TO BE ENDANGERED (SUCH AS A SUDDEN SEVERAL FOOT RISE IN LAKE LEVEL AND THREATENS TO OVERTOP THE EMBANKMENT)**, immediately contact the ECAO. Information to be reported should include current reservoir water surface elevation, observed water surface rise rate, weather conditions in the vicinity(past, present and predicted), and discharge condition of the Big Thompson River above and below the reservoir. The ECAO will provide instructions regarding reservoir operation and further reporting based on this report. Also, immediately open the spillway gates. As long as the gates can be opened to increase flows through the spillway, there is a good chance of relieving pressure on the dam embankment before major damage to the dam occurs.

¹¹ Ralph Beall and Tim Miller testified that, by the time of the events of the September 2013 storm, the Loveland Control Center had been relocated to the Casper Control Center.

- (5) A calculator program for flood routing is included in the SOP [Standard Operating Procedures] at the control house. This program will automatically compute changes in storage, inflow and outflow rates through Lake Estes, and can be used as a tool or aid to assist the operator during times of communication loss. This program should be used only by experienced operators familiar and competent with operation of the calculator and should not be used in lieu of criteria written in this Emergency Action Plan.
- (6) The LCC should notify the Estes Power Plant Foreman to contact all employees and schedule shifts for monitoring Olympus Dam. These shifts will consist of a minimum of three persons per 24 hour day, on a continuing basis, until the emergency no longer exists. When the water surface elevation at Lake Estes reaches 7,474.00 feet and a further increase is indicated, begin opening the No. 3 radial gate according to the following criteria:
 - (a) Record the elevation at time of arrival.
 - (b) Time the lake increase at 15-minute intervals, and record the elevation at the end of 15 minutes
 - (c) Take the difference of the beginning and ending elevations at the end of 15 minute interval and multiply by 10. This calculation will provide the change in gate opening for radial gate No. 3.
 - (d) Continue to operate the gate in this fashion for all elevations greater than 7,474.00 feet.
 - (e) If the water surface elevation should reach 7,475.75 feet and a further increase is indicted, begin opening the remaining four radial gats according to these criteria:
 - i. Record the elevation at 15-minute intervals.
 - ii. Take the difference of the beginning and ending elevations at the end of the 15-minute interval and multiply by 5. This calculation will provide the range in gate opening for the remaining gates.
 - iii. If the elevation should exceed 7,475.75 feet (within the 15 minute interval, use both equations to derive the gate settings.
 Note: Gate No. 3 uses a factor of 10 for the gate positions. The remaining gates use a factor of 5. These factors should not be used interchangeably as excess flows will occur.
 - iv. When the lake level begins to recede, begin decreasing gate openings according to the previously mentioned criteria.

(capitalization and emphasis in original; alteration and footnote added). Tim Miller testified at trial that, while the Hazard Specific Guidelines for floods would have been relevant to

the Bureau's response to the September 2013 storm, events during the flood could have necessitated resort to other Hazard Specific Guidelines as well, such as "erosion," "structural problems," "failures of different items" including "operational equipment," and "seeps." Mr. Miller further testified to his belief that, with respect to the Hazard Specific Guidelines for floods, in particular, the instructions in paragraph (6) to raise Gate 3 at 7,474 feet of elevation, and the remaining gates at 7,474.75 feet of elevation, "[t]his whole part was null and void during the flood," for the reason that "Gate 3 was not operable." (alteration added). According to Mr. Miller, under normal circumstances, the Bureau would "open Gate Number 3 until it reached the maximum remote operation, and then" the Bureau could "bring people to the dam to manually open the other gates or to open Gate 3 further" as necessary.

James VanShaar testified that he would not interpret the Emergency Action Plan "as indicating that we should not have opened Gate Number 3^[12] until arrival at 7474," and Mr. VanShaar stated that "[o]ther portions of the standing [sic] operating procedures gives us flexibility to operate the gates for other reasons and in other ways, and we did so." (alterations and footnote added). Mr. VanShaar also testified, however, that when the Emergency Action Plan is triggered, specific Emergency Action Plan requirements trump more general rules in the Standard Operating Procedures, and that the Emergency Action Plan is followed by operators in the absence of direction from the water schedulers.

A filled-out version of the form provided for in paragraph B.1. of the Hazard Specific Guidelines is included in the record before the court. The form, titled "**REPORT OF EMERGENCY OR UNUSUAL OCCURRENCE**," indicates that it was completed by Howard Bailey, the Bureau's security officer. (capitalization and emphasis in original). The Report of Emergency or Unusual Occurrences provides that Lake Estes reached an elevation of 7,473.89 at 11:30 p.m. on September 12, 2013, and that at 11:45 p.m. that night, Lake Estes experienced an inflow of 5,391 cfs and outflow of 5,377 cfs. The Report of Emergency or Unusual Circumstances further provides a brief summary of the events of the September 2013 storm at Olympus Dam:

Water Scheduler Carlos Lora contacted Emergency Manager Howard Bailey at/around 02:00 hrs and notified him of a heavy rain storm in the Estes Park area. This rain storm and the subsequent runoff is likely to continue raising the reservoir elevation and resulting in increased releases from Olympus Dam. Carlos recommended an Internal Alert (IA) that was subsequently declared upon consultation with the ECAO IMT. C-BT [Colorado-Big Thompson] Facility Manager Ralph Beall was appointed as Incident Commander.

(alteration added).

¹² Mr. VanShaar referred to Gate 3 in his explanation of the Emergency Action Plan, despite Gate 3 having been inoperable during the September 2013 storm.

Plaintiffs' Properties

Downstream of Olympus Dam, in Drake, Colorado, an unincorporated community in the Big Thompson River Canyon, is the confluence of the Big Thompson River and a tributary, the North Fork Big Thompson River. The parties stipulated that the North Fork Big Thompson River "has a separate watershed from the Big Thompson River," and above the confluence, releases from Olympus Dam do not affect flow in the North Fork Big Thompson River. The parties further stipulated that, at the time of the September 2013 events relevant to the case currently before the court, plaintiffs Howard and Lena Carman and Elizabeth Orr were owners of properties on the Big Thompson River downstream of both Olympus Dam and of the confluence at Drake, Colorado. The parties also stipulated that water released from Olympus Dam takes multiple hours to reach the properties of the plaintiffs, although the parties disagree on the approximate number of hours from the time of release from Olympus Dam before released water reaches the Orr and Carman properties. Because plaintiffs' properties were both downstream of Olympus Dam, in the Big Thompson River Canyon, as well as being downstream of the confluence at Drake, the primary events of the September 2013 storm which are relevant to this case occurred at Lake Estes and Olympus Dam or downstream thereof. The relevant releases from Olympus Dam are all downstream into the Big Thompson River, towards plaintiffs' properties.

The parties stipulated that Ms. Orr owned in September 2013, and continues to own, property off Highway 34 in Loveland, Colorado, "more than twelve-and-a-half miles downstream from Olympus Dam and more than half-a-mile downstream of the confluence of the rivers at Drake." Ms. Orr testified that at the time of the September 2013 flood, the property off Highway 34 was the site of a cabin originally built by Ms. Orr's grandfather, which was expanded in 2003 and 2004 into the structure that existed in September 2013. Ms. Orr testified that she has been the sole owner of the property off Highway 34 since 1976.

Ms. Orr testified, to her recollection, that the Big Thompson River flooded once prior to the September 2013 storm, on July 31, 1976. According to Ms. Orr, during the events of the 1976 flood, "it had rained off and on for several days," but there was not "particularly heavy rain in the canyon," and in the Big Thompson River, "the water level was less than in the 2013 [flood]." (alteration added). When asked about the damage of the 1976 flood to the property, Ms. Orr testified: "We did lose our septic system, and we lost our well, our water well, but there was no damage at all to the house." Ms. Orr further testified that the United States Army Corps of Engineers added "riprapping" to the banks of the Big Thompson River following the 1976 flood.

At the time of the September 2013 storm, Ms. Orr testified that her house was located approximately 150 feet from the bank of the Big Thompson River, although the older portion of the house, which was built by Ms. Orr's grandfather, was located closer than 150 feet to the river. Ms. Orr's property is located on the southern, or right, bank of the Big Thompson River and was connected to Highway 34 by a bridge over the Big Thompson River. At the time of the September 2013 storm, there were multiple structures on the property, including Ms. Orr's house, a barn, a second house identified by Ms. Orr

as “a play house for our children,” and a playground. According to Ms. Orr’s testimony, prior to the September 2013 flood, the Big Thompson River flowed “much closer to the highway” than it currently does, and Ms. Orr’s property had a large yard between the river and the house, as well as a buried septic system located in front of the house, approximately 150 feet from the Big Thompson River, which had been installed after the 1976 flood. Between the yard and the house were a rock wall, described by Ms. Orr as two-and-a-half to three feet high, the driveway that originally led to the older portion of the cabin, and a second rock wall. Ms. Orr testified that her house was “15 to 20 feet” higher in elevation than the Big Thompson River.

The parties stipulated that, at the time of the September 2013 flood, Howard and Lena Carman, a married couple, owned two adjacent parcels of land on Highway 34 in Loveland, Colorado. According to the parties’ stipulations, the Carmans’ home was located on one parcel on Highway 34, and on the adjacent parcel on Highway 34 was located the business the Carmans owned and managed, the Big Thompson Indian Village store (Indian Village store).¹³ According to the parties’ stipulations, the parcels owned by the Carmans “were about fifteen miles downstream from Olympus Dam and at least two miles downstream of the confluence of the rivers at Drake,” approximately one-and-a-half miles downstream from Ms. Orr’s property. Mr. Carman testified, corroborated by the Carmans’ deed to their property, that the Carmans, also owned an access easement over the eastern portion of an adjacent parcel, owned by Larimer County, Colorado, immediately to the west of the Carmans’ property. According to the testimony of Mrs. Carman at trial, the Carmans’ property was approximately 1,000 feet lower in elevation than Estes Park. Mrs. Carman testified that the Carmans first moved into their property in 1971, based on an agreement to lease the property for five years before purchasing it. Mr. Carman testified that the Carmans purchased their property in 1976.

Mr. Carman testified, similar to Ms. Orr, that prior to the September 2013 flood, the Big Thompson River had flooded in 1976. Mr. Carman testified that in the 1976 flood, falling power lines damaged the back corners of the Indian Village store, and the only damage to the Carmans’ house was to the basement, where a “four-foot section” of wall and corner “collapsed” and were “knocked out” by the 1976 flood. Mr. Carman further testified that the Carmans also lost a “guest cabin” and a barn in the 1976 flood. The Carmans purchased their property shortly after the 1976 flood, and the real estate contract by which the Carmans purchased the properties indicates that the Carmans were aware that the properties “may be located and situate in a flood plain.” At trial, the Carmans testified that because the lower portion of their property was located in a flood plain, the Carmans did not construct any permanent structures on that portion of their land. According to a plat included in the warranty deed which conveyed the Carmans’ properties to the Colorado Department of Transportation in 2016, the flood plain occupied a substantial portion of both parcels owned by the Carmans along the north bank of the Big Thompson River.

¹³ According to the testimony of Mr. Carman, at the Indian Village store, the Carmans sold “Indian stuff, rugs, pottery, jewelry, moccasins,” as well as “T-shirts” and “curio items.”

The Carmans' parcels were located on the northern, or left, bank of the Big Thompson River, along a bend of the river. The Carmans testified that they had multiple structures across the property, including the Carmans' house, the Indian Village store, a large, roughly S-shaped concrete wall which created a higher area of ground on the Highway 34 side of the property, as well as a horse trailer and a Connex¹⁴ box located on the lower portion of the property. On a grassy lawn by the river, behind a horse trailer and Connex box, the Carmans kept two horses¹⁵ in corrals which at the back were approximately four or five feet from the Big Thompson River. Mr. Carman testified at trial that at the highest point, the property was approximately 14 or 15 feet higher in elevation than the riverbank, and 20 or 21 feet higher in elevation than the water. According to the testimony of Mrs. Carman and a map of the property she had drawn, the Carmans' property was approximately 200 feet wide at the widest portion, from the parking lot of the Indian Village store to the Big Thompson River, while the house and store were approximately 75 feet from the Big Thompson River. On the north side of Highway 34, across from the parking lot in front of the Indian Village store, was a lower section of ground, which Mr. Carman at trial estimated was approximately six feet lower than the parking lot of the store and was referred to as the "borrow ditch." Behind the Indian Village store, the Carmans had a footbridge which reached across the Big Thompson River, which also carried a pipe which brought non-potable water from a hydroelectric plant located across the river.

Events of the September 2013 Storm

According to the parties' joint stipulations, under ordinary circumstances, "[t]he Bureau of Reclamation constantly releases water from Lake Estes into the Big Thompson River throughout the year," in order "to serve downstream water rights or environmental purposes," and the Bureau of Reclamation "must release a minimum amount of water," which "ranges between 25cfs and 125cfs depending upon the time of year," "from behind Olympus Dam into the Big Thompson for environmental purposes." (alteration added). The parties also stipulated that in the Big Thompson River Canyon, "[b]eginning at a flow level of 1,500cfs, water begins to flood permanent residences," while most structures "are inundated at flows of 6,000cfs." (alteration added).

The parties stipulated that, beginning on September 9, 2013, and lasting until around September 16, 2013, "significant rainstorms stalled over Larimer County, Colorado, including over Olympus Dam and the town of Estes Park." During the September 2013 storm, Estes Park, where Lake Estes and Olympus Dam are located, received 11.54 inches of rain, while the average annual rainfall for Estes Park is 16.32 inches, and the average September monthly rainfall is 1.40 inches. Drake, the location of the confluence of the Big Thompson River and North Fork Big Thompson River upstream

¹⁴ Mr. Carman testified that a Connex box is "what you see like a semi going down the road with."

¹⁵ In the parties' filings, including the joint stipulations, as well as testimony at trial, the Carmans' animals are described interchangeably as "two horses" and as "a horse and a mule."

of plaintiffs' properties, received 16.20 inches of rainfall during the September 2013 storm, while the average annual rainfall for Drake is 16.84 inches and, and the average September monthly rainfall is 1.50 inches. The parties stipulated that, in total, "15,640 acre-feet of water flowed into Lake Estes" during the September 2013 storm. According to the parties' joint stipulations, "[t]he peak of the storms" was a 48-hour period "between September 11 and 13, 2013:" 3.90 inches of rain fell in Estes Park from 7:00 a.m., September 11, to 7:00 a.m., September 12, and 3.74 inches fell in Estes Park from 7:00 a.m., September 12, to 7:00 a.m., September 13. (alteration added). The parties' stipulations also indicate that "[t]he annual exceedance probability of the September 2013 storm event ranged as low as 0.1%. In other words, the September 2013 storms may have been a 1,000-year storm event." (alteration added).

The parties stipulated that on September 12, 2013, multiple emergencies were declared by federal, state, and local governments. Also according to the parties' stipulations, "then-President Obama declared a federal emergency due to the storms and flooding;" "then-Colorado Governor John Hickenlooper declared a disaster emergency due to flooding in both Boulder and Larimer Counties;" and "[t]he city manager for the city of Loveland, Colorado declared a local disaster on September 12, 2013 due to heavy rains, flash flooding, closed roads, and property damage." (alteration added). According to the Post Incident Analysis Report prepared by the Bureau of Reclamation, however, "[b]efore and throughout the flood event, the Olympus Dam Early Warning System did not transmit any precipitation warnings."¹⁶ (alteration added). According to the testimony of Carlos Lora, who was the water scheduler on duty at the East Colorado Area Office of the Bureau of Reclamation from the night of September 11, 2013, until the afternoon of September 12, 2013, the Early Warning System's failure to transmit a precipitation was not the result of any malfunction in the system, but rather reflected that "the rainfall was so slow coming," and therefore did not trigger a warning.

Ms. Orr testified that on September 9 and 10, 2013, the area experienced "rain showers" and the water in the Big Thompson River near her property was approximately two feet below the riprap on its banks. The parties stipulated that prior to approximately September 11, 2013, the Bureau of Reclamation "was releasing 80cfs through Olympus Dam into the Big Thompson River," as well as "diverting 560cfs through Olympus Tunnel. The water level of Lake Estes was approximately 7,473.2 feet." Mrs. Carman testified at trial that on September 8, 9, and 10, 2013, it was raining "off and on," including a break in the rain the morning of September 10, 2013, and during that time the Big Thompson River was not noticeably higher than its normal flow. Based on weather forecasts, however, Mrs. Carman testified that she understood that there would be "a large storm coming, to expect heavy rain," especially "through Boulder, Lyons, and Estes Park," upstream from plaintiffs.

¹⁶ The Post Incident Analysis Report states that the Early Warning System at Olympus Dam "was calibrated to transmit warnings for extremely intense rainfall events (0.75 inches in 30-minutes or 1.50 inches in 1-hour). This rainfall event did not exceed these intensity thresholds, but other early warning systems elsewhere in Rocky Mountain National Park were triggered by the event."

According to the testimonies of Tim Miller and Anthony Curtis, the Bureau of Reclamation Resources Division chief, a team of water schedulers, operating within the Water Resources Group of the Resources Division of the Bureau, direct water releases from Olympus Dam, and “develop[] daily water schedules and long-term water schedules for movement of water to deliver to participants and contractees” in the C-BT Project. (alteration added). According to the testimony of Mr. Miller, the water schedulers’ function is to determine at what times and places to release water into the Big Thompson River as it is requested by contract holders. Commonly the water schedulers will release water into the river at the points where demand for power is the highest, so as to maximize power generation with their releases. According to the testimony of Mr. VanShaar, “[t]he Water Resources Group is responsible for issuing the water orders” each day, which “describes and prescribes the actions to move water through the system,” as well as “oversee[ing] portions of the Frying Pan, Arkansas, project, [sic¹⁷] and provid[ing] an oversight role for the Trinidad project in Southeastern Colorado.” (alterations and footnote added). According to Mr. VanShaar, water schedulers rely on “physical and statistical modeling, a role for forecasting, data analysis, data issuing,” as well as “maintain the data flow from various gauges.”

According to the testimony of Anthony Curtis, the water schedulers develop water orders which “specify the number of acre-feet [of water] to be delivered through each facility” of the C-BT based on requests submitted by Northern Water. (alteration added). The water schedulers send water orders to a number of entities, including Northern Water and WAPA, discussed above, and “the State Engineer’s Office, the district engineers, Colorado Parks and Wildlife, and counties and cities within the C-BT,” according to the testimony of Mr. Curtis. According to Mr. VanShaar and Mr. Lora, the water order for each day typically is released between 3:30 p.m. and 5:30 p.m., and contains a record of the instructions from that day as well as prospective instructions for the remainder of that day and for the next day.

At trial, Mr. VanShaar and Mr. Lora testified that the water scheduler on duty for September 11, 2013, into the morning of September 12, 2013, was Mr. Lora. Mr. VanShaar testified that during the storm, particularly between September 11, 2013, and September 13, 2013, the Bureau of Reclamation deviated from the water orders’ instructions, “[s]ometimes as frequently as once an hour or maybe slightly more frequent,” due to changes in the rain and runoff, and accompanying impacts on C-BT Project facilities. (alteration added).

Mr. Lora issued a water order in the afternoon of September 10, 2013, which contained prospective changes to flow in the C-BT Project through September 11, 2013. The September 10, 2013, water order states:

The Adams Tunnel flow will be reduced this evening to 450 cfs due to the stormy weather impacting the area. Depending on weather condition and

¹⁷ “Frying Pan, Arkansas, project” is how the name of that project appears in the transcript, however, the name of that Bureau of Reclamation project is actually spelled “Fryingpan-Arkansas Project.”

the runoff situation, we may decide to adjust that flow again tomorrow. The reduction will affect Marys and Estes powerplants output.

Despite the wet weather the region is experiencing today and tomorrow, we expect the Adams Tunnel to continue running high flows for the next several days. But towards the end of the month, conditions will change, and the diversions through Adams Tunnel will have to be reduced. After September 26th the flow will be reduced to only match demands for C-BT water. The reason for the flow reduction late this month is the outages scheduled for Flatiron Powerplant unit #3 and for the Charles Hansen Feeder Canal 550 Section. The annual maintenance for Flatiron unit #3 is scheduled to begin on September 23rd and will last 6 weeks, while the Charles Hansen Feeder Canal 550 Section work will begin on September 27th and will last only 2 weeks. Pumping to Carter Lake will likely resume late this week and will continue for 7 to 10 days.

The Estes Powerplant will have 800 acre-feet of water scheduled for power generation on Wednesday, a significant reduction from today's volume. Meanwhile, Flatiron units #1 and #2 will have 1,100 acre-feet available.

The September 10 water order includes among its "summary of flow changes," at midnight, September 11, "[a]djust the Adams Tunnel flow from 500 cfs to 450 cfs," and at 7:00 a.m., September 11, "[a]djust the Big T [Thompson] Powerplant flow from 230 to 237 cfs." (alterations added). With respect to the order to reduce flow through the Adams Tunnel, Mr. Lora testified that "during the day there had been rain in the area, so we wanted to make sure that we didn't go over the capacity of the system."

Mr. Carman testified at trial that on September 11, 2013, the Carmans did not open their store because the day was forecast to be rainy and cold, and the Carmans believed that "people would stay in the house." Mr. Carman also testified that the water in the Big Thompson River on September 11, 2013, was "a little higher" than it would otherwise have been, "like a spring runoff," while Mrs. Carman testified that the river on September 11 was "[w]ell within its banks." (alteration added). Ms. Orr testified at trial that on September 11, 2013, as late as approximately 8:00 p.m., she drove from Estes Park to her property down Highway 34, and at that time "[i]t wasn't raining hard at all," while the river was "still below the riprap" and within its banks. (alteration added).

At trial, Mr. Beall testified that, at some point prior to the peak precipitation of the September 2013 storm, he visited the Pole Hill Powerplant, the Flatiron Lake Powerplant, and the Big Thompson Powerplant. Mr. Beall was unable to identify the specific day or days that he visited the powerplants, but he noted that, with respect to the road to the Pole Hill Powerplant, a stream which crosses the road "got too large to cross, because we ended up stranding one of our work trucks there." Mr. Beall testified that "we had 550 [cfs] coming through our power plant in the afterbay, and whatever the gates at the bottom of Hells Canyon that was picking up this natural flow was delivering." (alteration added). Mr. Beall states that "PS-2 Jeff Cross and I got personnel together," and went "back down to the bottom of Hells Canyon, and go out in the concrete structure where the stem valves

are and lower those gates to get us back to 550 at the [Pole Hill] afterbay,” with the intent “[t]o close them so they’d quit diverting all the flood water that was coming down Little Hells Canyon into our very small afterbay.” (alterations added).

Moreover, Mr. Beall testified that at Flatiron Reservoir, he observed that “Cottonwood Creek, which normally runs very, very small, was bringing enough water into Flatiron [Reservoir] that our reservoir elevation was rising, and water scheduling wanted us to go check out the elevation circuits, make sure they were reading correct.” (alteration added). At the Big Thompson Powerplant, Mr. Beall testified that he disconnected the “regular power before it tripped” and “made the decision to get a generator on the deck of the power plant and tie it in to the sump pumps,” in order to ensure “that we had emergency power for our sump pumps to try and save that power plant.”

In the afternoon of September 11, 2013, Mr. Lora issued a water order containing a summary of that day’s changes and prospective changes to flow in the C-BT Project through September 12. The September 11, 2013 water order states:

The Adams Tunnel flow has now been reduced to 225 cfs due to the rainy weather and the high runoff. The change has impacted power generation for Marys and Estes powerplants. Inflow to Lake Estes tripled overnight, and is now over 300 cfs. With more rain predicted for tonight and tomorrow, there is a possibility that the generation for Marys and Estes powerplants may have to be curtailed at some point. The situation will be closely monitored. Any decisions will be made in a way that allows Western Area Power Administration and other parties as much time as possible to adjust to the changes.

Tomorrow at 0900 hours, the Flatiron unit #3 will begin pumping to Carter Lake once again. We expect the pump to run between 7 and 10 days.

The Estes Powerplant will have 520 acre-feet of water scheduled for power generation on Thursday, a significant reduction from today’s volume. Meanwhile, Flatiron units #1 and #2 will have 1,225 acre-feet available.

The September 11 water order includes among its “summary of flow changes,” at 7:00 a.m., September 12, “[a]djust the Big Thompson Powerplant flow from 237 to 385 cfs.” (alteration added). The September 11 water order also indicates, in its detailed list of flow changes, the instruction to “[m]aintain a flow of 550 cfs,” in the Olympus Tunnel for both September 11 and 12, 2013, as well as instructions to “[m]aintain a flow of 75 cfs” of releases through the Olympus Dam into the Big Thompson River for both September 11 and 12, 2013. (alterations added). With respect to the Water Resources Group’s motivation for reducing the Adams Tunnel flow, Mr. Lora testified that “we probably anticipated that we were going to have a little bit more runoff than we had had the previous days.” Mr. Lora further testified that flow in the Adams Tunnel was reduced “to accommodate water from the Big Thompson River that was coming into the system,” with the result that the powerplants at Marys Lake and Lake Estes would experience reduced power generation.

At trial, Mr. Lora testified that when he left work at the Bureau of Reclamation's Fort Collins office the evening of September 11, 2013, he "called Casper Control Center and asked them" to call him if the water in the Big Thompson River above Lake Estes reached a flow of 525 cfs. According to the parties' joint stipulations, the Bureau of Reclamation's response operations to the storm began "just after 11:30 p.m. on September 11, 2013," at which time "no dam operator was present at Olympus Dam."

The Bureau of Reclamation's Operating Log for the events of the September 2013 storm, kept by the Casper Control Center, is included in the evidence before the court. According to the Operating Log as it appears in the record before the court, at 11:40 p.m. on September 11, 2013, the gauge in the Big Thompson River above Lake Estes, which measured the inflow to Lake Estes from the Big Thompson River, was reading a flow rate of 525 cfs, an increase of 200 cfs from 7:00 p.m. earlier that evening.¹⁸ At 11:40 p.m., Casper Control Center called Mr. Lora, pursuant to his earlier instructions. In response, Mr. Lora instructed that the inflow from Adams Tunnel be reduced to 30 cfs, from 200 cfs, and that the Estes Powerplant, through which water enters Lake Estes from Marys Lake, be shut down. According to the parties' joint stipulations, at that time the Bureau of Reclamation reduced the inflows to Lake Estes as Mr. Lora instructed. Mr. Lora testified at trial that he "direct[ed] operations from [his] home" the night of September 11. (alterations added).

The Operating Log provides that at 12:18 a.m., September 12, 2013, "Lora called to verify Estes [Powerplant] units were off line; notified him that BT [Big Thompson River] Above is rising fast (now @ 650 cfs)," and that at 12:19 a.m., "Lora had me [Woodruff, the Casper Control Center employee on duty] raise BT Below Oly [Olympus Dam¹⁹] Rad [Radial] Gate #3 to verify we can control." (capitalization in original; alterations and footnote added). According to the parties' joint stipulations, a short time after midnight on September 12, 2013, the Bureau of Reclamation "began increasing its releases into the Big Thompson River via remote operation of a single spillway gate" at Olympus Dam. The Bureau would typically do this by remotely controlling Gate 3, the center gate, however, as reflected above, Gate 3 "was not in service during the September 2013 storm and the Bureau controlled spillway gate number 4 by remote operation." At trial Mr. Beall confirmed that "Radial Gate Number 3 was not operating at the time of the 2013 storm" and the Bureau was "using Gate Number 4 in place of number 3 for the Casper Control Center to operate" during the September 2013 storm. Mr. Beall testified that instructions contained in the Emergency Action Plan for Gate 3 in emergencies would be understood to apply to Gate 4, or Gate 2, depending on which gate was under remote operation.

The Post Incident Analysis Report prepared by the Bureau provides, in relevant part:

¹⁸ For comparison, according to the testimony of Mr. VanShaar, "the average inflow into Lake Estes in September" is "around 75 CFS."

¹⁹ "Olympus," Olympus Dam," and "Olympus Tunnel" are in some quotations abbreviated "Oly," "Oly Dam," or "Oly Tunnel."

As a precautionary measure, Gate No 3 was taken out of service prior to the flood due to a gear box issue. The gear box parts had been ordered and had not yet been installed; therefore, Gate No. 3 was not used for the duration of this incident. Prior the [sic] flood, Gate No. 4 was transferred to remote operation and was operated by CCC [Casper Control Center] up to the 2.5 foot limit when the dam operator arrived at the dam. Upon arrival, the operator was able to open Gate numbers 1, 2 and 5 to regulate reservoir operation per instruction from water scheduling through CCC operators.

This storm event required opening of 4 of the 5 functioning gates and required manual measurement of gate opening for determining operational releases from the dam. For a single dam operator this is an arduous task at best.

(alterations added).

At 12:40 a.m. on September 12, 2013, the Operating Log states: "Per Lora BT Below to 180 cfs (+100 cfs); BT Above is now 731 cfs. Carlos [Lora] is calling Burke to see if he can get personnel to E [Estes] PP [Powerplant]." (alterations added). At 12:50 a.m. on September 12, the Operating Log states: "BT Below to 280 cfs (+100 cfs) per Lora, BT Above is 796 cfs." According to the parties' joint stipulations, during this period, the water elevation in Lake Estes rose, and by "1:00 a.m. on September 12, the water level of Lake Estes had risen to 7,473.5 feet." The Operating Log at 1:05 a.m. on September 12, states: "BT Below to 380 cfs (+100 cfs)." Mr. Jonathan Haywood, a Bureau of Reclamation engineer, testified at trial that he received a phone call from Casper Control Center around 1:00 a.m. on September 12, asking Mr. Haywood to "come up and operate the [Olympus] dam to alleviate the water coming in." (alteration added).

The Operating Log at 1:30 a.m. on September 12, 2013, states: "BT Below to 480 cfs (+100 cfs); BT Above 1007 cfs." The Operating Log at 1:35 a.m. further states: "Lora called CCC; said to increase more out of BT Below +200 cfs to 680 cfs." Mr. Haywood testified that around 1:45 a.m., he arrived in Estes Park, and he described the weather as "torrential rain, like I hadn't seen before." The Operating Log at 1:57 a.m. states: "Per Lora BT Below to 900 cfs (+220 cfs); BT Above 1145 cfs E [Estes] FB 7473.62."²⁰ (alteration added). According to the testimony of Mr. Lora, between approximately 1:30 a.m. and 2:00 a.m., September 12, the gauge reading the flow in the Big Thompson River below Olympus Dam was lost, and as a result, through approximately the morning of September 13, the Bureau of Reclamation did not have an accurate measurement of the flow out of Olympus Dam.

The Operating Log at 2:01 a.m., September 12, 2013, states: "MLPP [Marys Lake Powerplant] off (East Portal [Adams Tunnel] flow @ 200 cfs)." (alterations added).

²⁰ The meaning of "FB" in the context of the Operating Log is unclear from the evidence before the court. Further, while it is not stated, the figure "7473.62" appears to indicate that the elevation of the water in Lake Estes at 1:57 a.m. on September 12, 2013, was 7,473.62 feet.

According to the testimony of Mr. VanShaar, Marys Lake Powerplant, through which water from the Western Slope flowed before reaching Lake Estes, “has a lower limit of about 200 cfs, at which point it shuts off,” but Mr. VanShaar indicated he did not know if Marys Lake Powerplant had been turned off by the Bureau of Reclamation or if the powerplant had turned off upon reaching its lower limit. According to the parties’ joint stipulations, Mr. Haywood “arrived at Olympus Dam at approximately 2:13 a.m. on September 12, 2013,” in order to operate the spillway gates, and the Operating Log also records Mr. Haywood’s arrival time as 2:13 a.m., September 12. Mr. Haywood testified that he “had to operate the gates of Olympus Dam outside” in the rain, and that he was “out standing on top of the dam.”

At trial, Mr. Lora testified that sometime “after midnight” on September 12, 2013, he called “the person in charge of declaring those [internal alerts] and woke him up” in order to “let him know that we may have to, you know, declare some kind of alert.” (alteration added). According to the parties’ joint stipulations, “at approximately 2:30 a.m., the Bureau of Reclamation declared an internal alert at Olympus Dam,” which is “the first and lowest of five alert levels at the dam.” According to the Operating Log, the Internal Alert was declared “due to high inflows @ BT [Big Thompson River] Above, rain storm in area.” (alteration added). Mr. Lora testified at trial that, upon the declaration of the Internal Alert at Olympus Dam, he did not “look to the Emergency Action Plan to determine how to adjust the outflows from Olympus Dam,” but instead made adjustments “based on whatever the inflow at that point was into the dam,” in part because Mr. Lora directed the operations of Olympus Dam from his home from the night of September 11 and September 12, and he did not have a copy of the Emergency Action Plan at his home.

According to the parties’ joint stipulations, “[j]ust before 3:00 a.m.” on September 12, 2013, Mr. Haywood raised each of the four operational gates at Olympus Dam to an opening of “approximately six inches.” (alteration added). The Operating Log states at 2:55 a.m. on September 12: “Haywood going to open all 5 Oly Radial Gates ½’ [foot] per Lora ≈ 1100cfs.” (alteration added). At trial, Mr. Lora confirmed that he instructed that all five of the radial gates at Olympus Dam be opened one-half foot, for an approximate release of 1,100 cfs into the Big Thompson River. According to the testimony of Mr. VanShaar, the release effected by Mr. Haywood opening the gates to six inches “would certainly qualify” for a declaration of Response Level 1.

The Operating Log indicates at 3:40 a.m. on September 12, 2013:

Per Haywood, Oly radial Gate #3 Gear Box is not working [and] there is no indication of gate opening – estimate is Gates 1, 2 & 5 are open 1’ [one foot] each & gate #4 in CCC [Casper Control Center] indicates 1.39’ [feet] BT Below ≈ 1200 cfs; BT Above 1285 cfs E [Estes] FB 73.81.^[21]

(alterations and footnote added). The parties stipulated that the Bureau of Reclamation declared Response Level 1 for Olympus Dam at 3:42 a.m. on September 12. According

²¹ “E FB 73.81” in the Operating Log appears to indicate that the water in Lake Estes had reached an elevation of 7,473.81 feet by 3:40 a.m. on September 12, 2013.

to the parties' joint stipulations, following this declaration, at 3:45 a.m., the releases of water through the spillway gates increased to more than 1,500 cfs into the Big Thompson River. The parties' joint stipulations further provide that the water in Lake Estes by this point had risen to an elevation of 7,473.8 feet, leaving 2.4 inches of vertical space in the reservoir's operational pool. The Operating Log at 4:15 a.m. on September 12, 2013, states that "Oly Gates 1, 2, 4 & 5 are open $\approx 1 \frac{1}{2}$ ' [feet] each," and 25 minutes later, at 4:40 a.m., "Oly Gates 1, 2, 4 & 5 are open ≈ 2 ' [feet] each, flow of 1400 cfs BT Below." (alterations added).

According to the parties' joint stipulations, the Bureau of Reclamation declared Response Level 2 for Olympus Dam at 5:15 a.m. on September 12, 2013, indicating releases of at least 1,700 cfs, and the Operating Log states at 6:00 a.m. on September 12: "Per Howard Bailey; Response level 2 @ Olympus Dam; outflows expected to reach 1700 cfs." The parties further stipulated that the National Weather Service, at 5:52 a.m. on September 12, issued a flood warning for the area including the Big Thompson River Canyon and other areas below Olympus Dam. According to the testimony of Mr. VanShaar, Response Level 2 was declared "because at that time the outflows [from Olympus Dam] were expected to reach 1700 cubic feet per second," in excess of the threshold for Response Level 2 set by the Emergency Action Plan. (alteration added). At 6:09 a.m. on September 12, Paula Baty²² sent an email to Mr. Bailey, Ms. Lamb, Mr. Northrup, Mr. Pedersen, and four others, which indicated that Response Level 2 had been declared, and stated that "[o]ur releases are expected to flood cabins in the canyon." (alteration added). At 6:15 a.m., September 12, the Operating Log states: "Per Lora lower Oly Gates 1, 2, 4 & 5 to ≈ 1.5 ' [feet] each." (alteration added).

Mr. VanShaar testified that on the morning of September 12, 2013, "[t]he rain was still strong and without break, which is a little unusual for Colorado," that "[t]his was a sustained rain" and "continual," while "there was limited visibility" in the direction of the mountain, and "[t]here were no breaks in the clouds." (alterations added). Beginning on the morning of September 12, 2013, the Water Resources Group "moved from a regular eight-hour shift" to alternating shifts of twelve hours on and off, "around the clock, for the next several days."

According to the testimony of Mr. Carman, on the morning of September 12, 2013, the Big Thompson River "was running bank full" and "was coming up on the sides of that riprap" near the Carmans' property. Mrs. Carman similarly testified that the Big Thompson River was "flowing pretty heavily," that it was "two or three feet" below the edge of the bank, approximately half of the five to six feet distance from the bottom of the river to the banks, and because of the water's movement "you couldn't see the bottom of the river." According to Mrs. Carman, because of the increased height of the river and weather forecasts, Mr. Carman moved much of his equipment, including his backhoe, out of the

²² As noted above, at trial Ms. Baty, a safety engineer at the Bureau of Reclamation's East Colorado Area Office, went by the name Paula O'Brien.

lower portion of the Carmans' property, located in a floodplain, to the higher section of their property closer to the highway.

The Operating Log at 7:10 a.m. on September 12, 2013, states: "Per Carlos [Lora], lower BT-below radial gates $\frac{1}{4}$ ' [foot] or 3" [inches] = 1:10 on gate # 4, gates # 1, 3 & 5 show no indication."²³ (alterations added). At 7:14 a.m. on September 12, the Operating Log further states: "Per Carlos [Lora], Take Big-T-PP [Big Thompson Powerplant] off & just pass extra water to flow-North (Big-T # 1 off)?" (alterations added). Mr. Miller testified at trial that at 7:32 a.m. on September 12, he sent a text message to Mr. Lora and Ms. Lamb at the Bureau of Reclamation indicating that the Bureau could begin capturing water, and that the Big Thompson Powerplant and the Wasteway²⁴ should be turned off to allow the water to be captured at Horsetooth Reservoir.²⁵ Mr. Miller was unaware, however, of whether Mr. Lora or Ms. Lamb took his advice and began storing water as Mr. Miller had suggested.

Ms. Orr testified that between approximately 7:30 a.m. and 9:00 a.m. on September 12, 2013, she received a recorded emergency "reverse 911" phone call to her home landline telephone informing her of the need to evacuate her home.²⁶ According to

²³ The Operating Log does not clarify the meaning of "no indication" at 7:10 a.m., September 12, 2013.

²⁴ At trial, Mr. VanShaar referred to the Wasteway as "the second portion of the trifurcation."

²⁵ Mr. Miller's advice to begin capturing water appears to indicate that the Big Thompson River was in a "free river condition." In his testimony at trial, Mr. Curtis defined a "free river condition" as one where the water in the river system exceeds the amount of water allocated to those holding rights to the water. Mr. Curtis explained at trial that during a free river condition, water can be captured from the river system without regard to priorities or rights in that water. According to the testimony of Mr. Beall, during a free river condition the Bureau can capture water by diverting it via the 550 Section of the Charles Hansen Feeder Canal to the Horsetooth Reservoir.

²⁶ Admitted at trial without objection, but not testified to, is defendant's exhibit 2006, a "Broadcast Detail Report" which states it is "provided by Everbridge" and was described by defendant's counsel at trial as the "certified business records of the Larimer Emergency Telephone Authority" documenting "emergency broadcasts to the Big Thompson Canyon during the 2013 storm." The Broadcast Detail Report includes records of two emergency calls which appear to have been made in the window of time in which Ms. Orr testified she received her "reverse 911" phone call. One "Broadcast Summary" included in the Broadcast Detail Report indicates that an emergency call was sent to 183 "Members" on September 12, 2013, between 7:11:24 a.m. and 8:11:00 a.m. The Broadcast Detail Report indicates that another emergency call was made, also on September 12, 2013, to 71 "Members," between 7:21:53 a.m. and 8:21:00 a.m. Both calls, according to maps included in the Broadcast Detail Report, were made to locations along Highway 34, the highway along which the Orr and Carman properties were located.

Ms. Orr's testimony, Ms. Orr did not evacuate her home upon receiving the call, and afterwards, based on a conversation she had with an unidentified person who "came down as far as they could on Highway 34," she understood that Highway 34 was out both towards Estes Park and towards Loveland, further down the Big Thompson River Canyon. Around the time she received the recorded call, Ms. Orr testified that the water in the Big Thompson River had risen two feet from its usual height, above the riprap on the bank, and had come onto the grassy yard fronting the river on her property. Water from the Big Thompson River continued to flow onto Ms. Orr's property for the remainder of the day, while Ms. Orr testified that she remained at her home.

According to Lake Estes elevation data, jointly submitted by the parties, for the period from September 11, through September 13, 2013, at 8:00 a.m. on September 12, 2013, the elevation of the water in Lake Estes was 7,472.16 feet, approximately 1.65 feet lower than its elevation at around 3:40 to 3:45 a.m. that same morning. Beginning between 8:00 a.m. and 8:30 a.m. on September 12, the elevation of Lake Estes rose until 1:30 p.m. on September 12, when the elevation reached 7,473.7 feet.

The Operating Log at 9:30 a.m. on September 12, 2013, states: "Adams tunnel to 0 cfs per Carlos [Lora]." (alteration added). Mr. VanShaar testified that this closing of the Adams Tunnel gate was the first attempt to stop flows entering from the Western Slope of the Continental Divide. At 9:39 a.m. on September 12, 2013, Mr. Lora sent an email to Michael Collins, Jacklynn Gould, Charles Pedersen, Ralph Beall, Carlie Ronca, David Burke, Howard Bailey, Paula Baty, Adam Northrup, Kara Lamb, and James VanShaar, all of the Bureau of Reclamation, which Mr. Lora testified was unusual but done "to inform management of what was happening." In the email, Mr. Lora stated: "1- Last night releases from Oly Dam were increased to perhaps as much as 2,000 cfs (estimated). The rating for the gage below does not go that high, so the flow could not be measured." (alteration added). Mr. Lora testified at trial that estimation of the releases was necessary because the flow gauge below Olympus Dam had been lost between approximately 1:30 a.m. and 2:00 a.m. on September 12, and was not providing accurate information during September 12 and the morning of September 13. In the email, Mr. Lora further stated:

2- Inflow to Lake Estes exploded rapidly after midnight.

3- The Adams Tunnel was shutdown at midnight, while the generation for Marys ad [sic] Estes Powerplants was stopped.

4- Four gates were used to chase the flood.^[27]

5- Notifications began just after midnight among ECAO personnel, and later expended to outside agencies (Howard [Bailey] and Kara [Lamb]).

²⁷ At trial, Mr. Lora explained that when the Bureau of Reclamation was "chas[ing] the flood," "[w]e were increasing releases until we were able to match the inflow." (alterations added).

6- The reservoir level reached 7473.8 ft before we were able to turn it around. The upper operational limit is 7474.0 ft.

7- Currently the reservoir level is approximately 7472.50 ft and we are in the process of reducing releases.

8- We estimate the current reservoir release to be approximately 1,400 cfs, although we continue to adjust.

9- Big T [Thompson] Powerplant is now off. We are now in priority to capture Big Thompson River water.

(alterations and footnote added). Mr. Lora testified at trial that at the time the email was sent, “the inflows to the reservoir dropped unexpectedly, and even though we were trying to level off the reservoir, it kept dropping and dropping. It’s a very small pool, so it’s very reactive.” Mr. Lora further testified that at the time the email was sent, the State of Colorado was allowing the Bureau of Reclamation “to capture as much water as we could use in the lower part of the system to generate power,” and “we could actually keep the water and put it Horsetooth Oregon [sic²⁸] Carter Lake.” (alteration added).

At approximately 10:00 a.m. on September 12, 2013, Mrs. Carman testified that she received a recorded emergency “reverse 911” phone call to her home landline telephone, and the call left Mrs. Carman with the impression “that the Olympus Dam was going to open one gate and that we were to expect some high water.”²⁹ Mr. Carman testified that at approximately 10:00 a.m., water from the Big Thompson River began to flow onto the lawn of the Carmans’ properties, and Mr. Carman began relocating items from the basement of the Carmans’ house to the first floor, in anticipation of the water entering the basement. Additionally, according to Mrs. Carman’s testimony, Mr. Carman moved the Carmans’ horses up from the corrals in the floodplain and the Carmans “locked them in the yard between the house and the store” at the highest level of the property.

Mr. VanShaar testified that, around 10:30 a.m. on September 12, 2013, the Pole Hill Powerplant, through which water flows when released from Lake Estes via the Olympus Tunnel, was experiencing overheating problems. Mr. VanShaar indicated that the crew at the Pole Hill Powerplant attempted to keep the plant operational for approximately the next hour. Mr. Lora further testified that the Pole Hill Powerplant during this time was “tripping,” or going offline, because of the sediment being carried by the floodwaters, and that when the powerplant went offline, water could no longer flow through it. Mr. Beall also testified that at the Pole Hill Powerplant, “[t]he water was so dirty

²⁸ The trial transcript records Mr. Lora as saying “Horsetooth Oregon Carter Lake.” Based on the context in which Mr. Lora was speaking, it is more likely he actually said “Horsetooth or in Carter Lake.”

²⁹ The Broadcast Detail Report included in the record before the court does not appear to document a “reverse 911” phone call which was made to the area in which the Carmans lived within the approximate time frame stated by Mrs. Carman.

and carrying so much sediment that it was plugging up our filters, our strainers that we use to intake water for cooling water for our bearings as we generate.” (alteration added).

According to the Post Incident Analysis Report, the Bureau of Reclamation decided at approximately 10:30 a.m. on September 12, 2013, “to allow reservoir to rise slightly (store water).” According to the testimony of Mr. VanShaar, the Bureau made the decision to allow the reservoir to rise because

[w]e were buying time for our neighbors and our partners to respond to what had happened overnight, both the folks that might be trying to get in the canyon and get people out. The City of Loveland, which is about seven, eight hours downstream of the dam, we were buying time for them to respond as best they could. If we could use a little bit of that space and delay further increases, we decided to do that.

(alteration added). According to the Post Incident Analysis Report, at 10:30 a.m. on September 12, Mr. VanShaar was “announced as representative to the Loveland EOC [Emergency Operations Center]” as well as “technical specialist,” and at this time, “[c]ontinuous staffing by an ECAO technical specialist at the Loveland EOC begins.” (alterations added). Mr. VanShaar described his work as the ECAO’s representative as “interact[ing] with the City of Loveland and their response to help them understand what we were doing on the river” for the duration of the storm. (alteration added). Mr. VanShaar testified that at that time, the Bureau anticipated further “releases that could threaten lives or property,” and that they “were buying time for the emergency response to move forward, some of which would have been people to evacuate,” out of concern regarding the water the Bureau had already released as well as potentially worsening conditions.

According to the parties’ joint stipulations, the Bureau of Reclamation declared Response Level 3 for Olympus Dam at 11:30 a.m.³⁰ on September 12, 2013, the highest response level declared during the course of the September 2013 storm. The parties further stipulated that the declaration of Response Level 3 by the Bureau of Reclamation did not reflect a belief of “any danger of impending failure of Olympus Dam.” At trial, Mr. VanShaar testified that “[w]hen we entered into Response Level 3, we knew we were dealing with flows that would impact property and had the potential to impact the safety of human life downstream.” (alteration added). Mr. Beall testified that the time between the declaration of an Internal Alert and the declaration of Response Level 3, “[e]ight or nine hours,” was the shortest such span of time that he could recall. (alteration added). The Operating Log, however, does not record the declaration of Response Level 3 until 1:00 p.m. on September 12, 2013

The Operating Log at 11:39 a.m. on September 12, 2013, states: “PH [Pole Hill Powerplant] #1 to local, taking unit off do [sic] to personnel safety reasons so crew can

³⁰ Mr. Miller testified that he recalled attending a meeting at which the declaration of Response Level 3 was decided, which occurred during “the night of the -- of the 12th,” rather than the morning of September 12, 2013, as indicated in the parties’ joint stipulations and the Operating Log.

leave the area.” (alterations added). According to Mr. VanShaar, by 11:46 a.m. on September 12, no water was flowing through the Pole Hill Powerplant. Mr. VanShaar testified that with the Pole Hill Powerplant shut down, the water in the Olympus Tunnel was then redirected through the Pole Hill Rediversion Structure in Little Hells Canyon, and from there into Pinewood Reservoir.

The Operating Log at 12:00 p.m. on September 12, 2013, states: “Per Carlos [Lora] +6” [inches] each Radial gate at Estes dam in 5 min [minute] increments.” (alterations added). Mr. Miller testified at trial that “at noon on September 12th,” Olympus Dam was releasing “approximately 3400 cfs,” per the notes taken by Mr. Miller contemporaneous with the September 2013 flood event. The Post Incident Analysis Report states that “[a]t around 1:00 p.m. on the 12th, unusually high local runoff” caused increased flow which “raised the water surface elevation of Marys Lake above 8040.0 feet, pushing it into Internal Alert.” (alteration added). The Operating Log at 1:00 p.m. on September 12 states: “Per Carlos [Lora] Oly Tunnel -150 = 400 [cfs] total. Per Howard Bailey Estes is now at Response level #3, also Marys is now in an Internal Alert.” (alterations added). At trial, Mr. Miller testified that the water schedulers decided to lower the flow through the Olympus Tunnel because the Pole Hill Powerplant had been shut down, in order to prevent the full 550 cfs flow from entering Little Hells Canyon. Mr. Miller testified that, because Marys Lake, which was upstream of Lake Estes, had reached a water elevation of 8,040.29 feet, near the top of its operational pool, due to increased flows from the storm and triggering an Internal Alert, the water schedulers decided to allow water from Marys Lake to pass downstream through the Estes Powerplant and into Lake Estes. The Operating Log at 1:10 p.m. on September 12 additionally states: “Per Carlos [Lora] increase Oly Radial Gate #4 (3”) & gate #2 (3”).” (alterations added).

The parties stipulated that as a result of taking the Pole Hill Powerplant offline, the Rediversion Structure in Little Hells Canyon was inundated with flows from Olympus Tunnel as well as natural inflows. Mr. VanShaar testified that the 1:00 p.m. on September 12 reduction in Olympus Tunnel flow occurred because “prior to that reduction, the 550 [cfs] would have been bypassed and landed in that natural channel [Little Hells Canyon], where it would have joined with natural runoff from the rain, flowed down to the rediversion site,” with the effect that “more water was being diverted into the rediversion than could be handled by the infrastructure.” (alterations added). Mr. VanShaar further testified that, as a result of the high flows, United States government property, including the “canal banks” of the Rediversion Structure, was damaged.

Mr. Beall explained in his testimony that water had to be diverted away from the Pole Hill Powerplant as a result of the influx of sediment, rather than simply shutting the power generation off and allowing water to continue flowing through, “[b]ecause it has to run through our turbine, and the bearings, when you make electricity, generated a lot of heat. The bearings are water-cooled, and that cooling water has protection circuits of flow and pressure that will not allow the unit to run unless they’re satisfied.” (alteration added). To continue to run water through the turbines while the plant was shut down, Mr. Beall testified, would have caused “catastrophic bearing failure.”

Mr. Beall further testified that “clos[ing] the gates between Pole Hill afterbay and Little Hells Canyon” also was done “to prevent the very small levee of the Pole Hill afterbay from being overtopped” between Pole Hill Powerplant and Pinewood Reservoir, and thereby prevent the levee from sustaining damage. (alteration added). According to Mr. Beall’s testimony, the Bureau of Reclamation also sought to “lower the water in the 930 section [of the Charles Hansen Feeder Canal],” in order to prevent adding water to the Trifurcation system near the mouth of the Big Thompson River Canyon, downstream of plaintiffs’ property. (alteration added). Mr. Beall further explained that in the previous flood in 1976, a siphon located in the Trifurcation tore away after its “supports eroded and washed away,” and the Bureau’s “concern was to lower the water in the 930 section so that in the event the siphon tore away during this [September 2013] flood, we would not be adding water to the river through the 930 section.” (alteration added). Mr. Beall testified that “there was already flooding at the mouth of the canyon” near Loveland when the Bureau decided to reduce the water in the 930 Section of the Charles Hansen Feeder Canal, and the flooding was “from the main fork and the north fork of the Big Thompson River, primarily, plus all the rainfall.”³¹ Mr. Beall indicated that water from the 930 Section of the Charles Hansen Feeder Canal would contribute to the downstream flooding in Loveland, which is “why we [the Bureau] turned off that source” by stopping additional water from flowing into the 930 Section. (alteration added). According to Mr. Beall, the decision to stop flows into the 930 Section impacted “the operation of the Olympus Tunnel” because “[l]ong term, we have to have Olympus Tunnel closed to quit moving water through the 930 [Section] unless we’re pumping to Carter [Lake] with Unit 3 at Flatiron.” (alterations added). When asked to clarify that shutting off water flowing into the 930 Section did not necessitate closing the Olympus Tunnel, because “you [the Bureau] would pump that to Carter [Lake],” Mr. Beall answered: “Right. We have – we have done that many times, yes.” (alterations added).

According to the testimony of Mr. Lora, around 3:00 p.m. on September 12, 2013, Mr. Lora returned to his home to rest and Mr. Miller assumed water scheduling duties. According to the testimony of Tim Miller, after Carlos Lora left, the only schedulers on duty at the Loveland office were Tim Miller and Ron Thomasson. The Operating Log at 3:00 p.m. on September 12 states: “Per Bailey releases out of Oly Dam are now @ 3600 cfs, still Response level 3.” (alteration added). According to Mr. Miller’s testimony at trial, supported by Mr. Miller’s notes taken contemporaneously with the Bureau’s response to the September 2013 flood, at 3:00 p.m. on September 12, flows through the Flatiron Powerplant were lowered such that power generation was reduced by twenty megawatts, while at the Estes Powerplant, flowing into Lake Estes, heightened flows increased power generation by five megawatts. The Operating Log reflects the decision to increase flows through the Estes Powerplant into Lake Estes, stating at 3:10 p.m. on September 12, “E [Estes] #3 on per Miller as Marys Lake is to [sic] full (5 mw’s).” (alterations added).

At 3:15 p.m. on September 12, 2013, the Operating Log further states: “Oly Tunnel -100 cfs = 300 per Miller.” (alteration added). Mr. Miller’s testimony and his

³¹ Mr. Beall clarified that, with respect to flooding in Loveland, he did not “know whether flooding in Loveland came from other sources besides the Big Thompson River,” and stated: “I don’t know where all that water came from.”

contemporaneous notes, which were admitted as an exhibit at trial, corroborate that the Olympus Tunnel flow was decreased to 300 cfs, although Mr. Miller's notes indicate that such decrease occurred at 3:00 p.m. rather than 3:15 p.m. Mr. Miller testified that this decrease of 100 cfs was ordered to "reduce the flow through Little Hells Canyon." Mr. Miller further testified that, assuming all other inflows into and outflows from Lake Estes remained constant, the effect of reducing flows through the Olympus Tunnel would be to increase the elevation of water in Lake Estes.³²

The Operating Log at 6:00 p.m. on September 12, 2013, states: "Oly Tunnel -100 cfs = 200 per Miller." (alteration added). At trial, Mr. Miller explained that "we were still in bypass [of the Pole Hill Powerplant], over the Little Hells Canyon diversion dam, and it [Olympus Tunnel] was just adding more flow to that canyon that didn't belong there." (alterations added). Mr. Miller testified that the water flowing into Little Hells Canyon "was going over the top of that diversion structure," and that the Bureau employees "weren't able to capture it" in order to "bring it back to Pinewood Reservoir" and the terminal reservoirs. Mr. Miller further testified that "assuming all other inflows and outflows remained the same," that "reducing outflows through the Olympus Tunnel" by 100 cfs "would have increased" the elevation of water in Lake Estes "by 100 cfs" as a result.

Mr. Miller testified, supported by his contemporaneous notes from the September 2013 flood, that at approximately 7:00 p.m. on September 12, 2013, Olympus Dam Gates 1 and 5 were opened an additional three inches, leading to an increase in releases of 217 cfs. The Operating Log at 7:15 p.m., September 12, 2013, states: "Per Miller Increase Oly Radial Gates by 217 cfs total of ½' [foot] increase." (alteration added). According to an email, dated September 12, 2013 at 7:52 p.m. and verified by the testimony of Ms. O'Brien, at 7:15 p.m., releases from Olympus Dam were approximately 3,800 cfs, while "[i]nflow into Lake Estes is estimated to be 3,900 cfs." (alteration added).

The Operating Log states at 7:25 p.m. on September 12, 2013, that "Oly Radial Gate #1 & Gate #5 increased by 3" [inches] each – total opening 24" [inches]." (alterations added). Mr. Miller testified at trial that the "total opening [of] 24" [inches]" on the Operating Log reflected the "estimated" amount of the openings of Gates Numbers 1 and 5 by the Bureau personnel at that time. (alterations added). The Operating Log further states at 7:35 p.m. on September 12, "Per Miller @ 2000 CHFC from 450 cfs to 350 cfs." Mr. Miller testified at trial that the entry at 7:35 p.m. on September 12 reflects an instruction he had given to reduce flow through the Charles Hansen Feeder Canal, the canal downstream of the Big Thompson River Canyon, by 100 cfs at 8:00 p.m. that same day. At trial, Paula O'Brien testified that she agreed with the statement, contained in a Bureau of Reclamation email from 7:52 p.m., that "[t]he dam is safe and performing well," (alteration added), and Ms. O'Brien explained that "the dam was being operated as we needed it to be operated. We were able to pass the flows safely without experiencing any particular damage to the facility that could affect the structure or the operation of the facility." The Operating Log further states at 7:55 p.m. on September 12, "[p]er Miller Increase Oly

³² According to the testimony of Mr. VanShaar, no water order was issued in the afternoon of September 12, 2013.

Radial Gates by ½' [foot] – increase 3" [inches] on Gate #2 & Gate #4.”³³ (alterations added). Mr. Miller testified, supported by his contemporaneous notes from the September 2013 flood, that at approximately 8:00 p.m. on September 12, releases through Olympus Dam increased by 220 cfs over the amount being released an hour previously, for a total approximate flow, as the Bureau estimated at that time, of 4,000 cfs.

In an email sent by Ms. Baty to East Colorado Area Office personnel, including Mr. Northrup, at 8:29 p.m. on September 12, 2013, Ms. Baty stated that “[d]am operators have conducted visual inspections” of the Marys Lake Dikes, Olympus Dam, and the East Portal Dam, “using the monthly OVIC forms^[34] for guidance. There are no issues of concern at any of the facilities in terms of the stability of those structures.” (alteration and footnote added). Ms. Baty’s email further stated:

We intend to stay below First Fill at Mary’s [sic] and barring any unforeseen equipment issues, are confident that we will be able to maintain control of the reservoir level.

Another issue we are dealing with, that is influencing our flow operations, is the condition of the Little Hells [Canyon] Diversion Dam. This is a low hazard dam^[35] but has significant affect [sic] on our operations of the Pole Hill powerplant and the way we run water through the cbt [Colorado-Big Thompson] system. If you recall it is associated with the afterbay of the Pole Hill powerplant. We have been taking some of the inflows into Lake Estes and running them through the Oly Tunnel to minimize river releases.

³³ At trial, Mr. Miller did not fully clarify the meaning of the 7:55 p.m. entry. Mr. Miller appeared to indicate that the notation “increase 3” [inches] on Gate #2 & Gate #4” referred to an increase of three inches to the named gates in addition to the half-foot increase otherwise prescribed for all gates in the 7:55 p.m. entry. (alteration added). Mr. Miller stated immediately thereafter, however, “I don’t understand what that means,” referring to the 7:55 p.m. entry, and when Mr. Miller was asked by plaintiffs’ counsel, “Is that unclear, whether it’s a half-a-foot increase or a three-inch increase?” Mr. Miller responded, “Yeah, it is.”

³⁴ At trial, Ms. O’Brien testified that “OVIC” stands for “Observations of Visual Inspections Checklist.” She testified to the nature of the OVIC forms and indicated that engineers performing inspections with the forms would only indicate a concern on the forms if they discovered a change from a prior inspection. Mr. Northrup testified that OVIC forms “are checklist forms that dam operators use to inspect a dam, and it’s a guideline form where they read a question and they check yes or no.” Mr. Northrup further stated that the OVIC form is “put together by engineers to assist dam operators for looking for problems.”

³⁵ Ms. O’Brien testified at trial that “low hazard dam” indicates “that, in the event of failure, you do not expect either loss of life, and you don’t reasonably expect loss of, say, a high economic value downstream.”

However, there has been damage to the stoplogs³⁶ and we have had to reduce what we are taking through the tunnel in order to prevent further damage. Personnel are in the process of getting to the site to see the condition of the structure since we reduced flows.

(alterations and footnotes added). At trial, Mr. Northrup testified that “[f]irst fill is a water elevation on a dam that we’ve never seen before, that the dam has never experienced before.” (alteration added). Mr. Northrup stated that first fill³⁷ had previously been reached at Olympus Dam, at an elevation of 7,475.25 feet, and at that instance of first fill, Olympus Dam did not fail.³⁸

Mr. Miller testified, supported by his contemporaneous notes, that at approximately 8:30 p.m. on September 12, 2013, increases through Olympus Dam were increased by an additional 220 cfs, however, the Bureau’s estimate of total flow through Olympus Dam at this time was revised to 3,800 cfs.³⁹ The Operating Log states, at 8:30 p.m. on September 12, “Per Miller Increase Oly Radial Gate #4 by ½’ [foot].” (alteration added). The Operating Log additionally states at 9:00 p.m., “Per Miller Increase Oly Radial Gate #1, 2, 4 & 5 by 3” [inches] each - CCC can only raise Oly Radial Gate #4 to 2.5’ [feet] (BT Below ≈ 4100 cfs).” (alterations added). Mr. Miller confirmed in his testimony, also supported by his contemporaneous notes, that at approximately 9:00 p.m. on September 12, releases through Olympus Dam were increased by 300 cfs, for a total flow of approximately 4,100 cfs. Mr. Miller explained at trial that, while he requested at 9:00 p.m. that all four operational gates be opened an additional three inches, Casper Control Center, which was at that time remotely operating Gate 4, could not raise Gate 4 above 2.5 feet, because “the limiter on that Gate 4 was set to 2.5 feet.” Therefore, Mr. Miller testified that at 9:06 p.m. on September 12, Gate 4 was taken off remote control and was from that point controlled “by the people onsite” at Olympus Dam. The Operating Log documents this change at 9:06 p.m. on September 12: “Oly Radial Gate #4 to LOCAL by Lannis.” (capitalization in original). Mr. Miller clarified in his testimony that he “would give

³⁶ Ms. O’Brien at trial described a “stoplog” as “usually a wooden or a metal log that slides down into channels such that you’re able to stop the flows at that location.”

³⁷ “First fill” was described by Paula O’Brien as “the first time that the reservoir has filled to a given elevation.”

³⁸ Mr. Northrup’s account of the first fill of Olympus Dam being at the elevation of 7,475.25 feet is supported by a text message sent at approximately 3:11 p.m. on September 12, 2013 by Ms. Baty to Mr. Northrup and nine others, which stated: “Oly dam first fill is 7475.25- we have a few feet there and are avoiding that anyway because of gate 3 position.”

³⁹ Mr. Miller indicated at trial that the downward revision of the Bureau’s estimate of total flow through Olympus Dam at 8:30 p.m. on September 12, 2013, was due to the Bureau “getting a more accurate number of what the gate position opening was.”

the orders to Casper Control Center, and then they would give the orders to the operators who were onsite at the dam.”

Mr. Miller testified, further supported by his contemporaneous notes, that at approximately 10:30 p.m. on September 12, releases through Olympus Dam were increased by 340 cfs, for a total release of approximately 4440 cfs. The Operating Log at 10:30 p.m. on September 12 states: “Oly Radial Gates #1, 2, 4 & 5 raised 3” [inches] each per Miller.” (alteration added). Mr. Miller further testified that at 10:40 p.m. on September 12, there was a further increase of 330 cfs in Olympus Dam releases, for a total release of approximately 4770 cfs. At 10:40 p.m. on September 12, the Operating Log states: “Oly Radial Gates #1, 2, 4 & 5 raised 3” [inches] each per Miller,” with a total release of approximately 4800 cfs. (alteration added). At 10:59 p.m. on September 12, the Operating Log states: “Oly Radial Gates #1, 2, 4 & 5 raised 6” [inches] each per Miller ≈ 5300 cfs.” (alteration added). At trial, Mr. Miller, again supported by his contemporaneous notes, corroborated that at approximately 11:00 p.m. on September 12, releases through Olympus Dam were increased, however, Mr. Miller testified that the increase was of 650 cfs, for a total flow through Olympus Dam of approximately 5,420 cfs.

According to data collected by the Bureau of Reclamation with respect to the elevation of Lake Estes during the September 2013 flood, at 11:15 p.m. on September 12, 2013, the water in Lake Estes reached an elevation of 7,473.86 feet. According to the same data source, fifteen minutes later, at 11:30 p.m., the water in Lake Estes reached an elevation of 7,473.89 feet, the highest elevation recorded during the September 2013 storm. The Standard Operating Procedures for Olympus Dam, the Estes Powerplant, and Lake Estes indicate that the storage capacity, or volume of water held, of Lake Estes at 7,473.8 feet of elevation is 2,442.3 acre-feet of water, while the capacity of Lake Estes at 7,473.9 feet of elevation is 2,460.0 acre-feet of water, indicating that one-tenth of a foot of elevation increase from 7,473.8 to 7,473.9 feet corresponds to an increase of 17.7 acre-feet of storage capacity. At trial, Mr. Miller calculated, based on the storage capacity of Lake Estes provided in the Standard Operating Procedures, that the increase in Lake Estes’ elevation from 7,473.86 feet at 11:15 p.m. to 7,473.89 feet at 11:30 p.m. on September 12 indicated an increase in storage capacity of 5.31 acre-feet.⁴⁰ From the figure of 5.31 acre-feet, Mr. Miller further calculated at trial, based on a “Reservoir Inflow Calculation Sheet” included in the Post Incident Analysis Report prepared by the Bureau, that the inflow from 11:15 p.m. to 11:30 p.m. was 257 cfs.

Mr. Miller testified at trial, supported by his contemporaneous notes, that at approximately 11:30 p.m. on September 12, 2013, releases through Olympus Dam were increased by 705 cfs, for a total release of approximately 6,125 cfs. The Operating Log at 11:35 p.m. states: “Oly Radial Gates #1, 2, 4 & 5 raised 6” [inches] each per Miller ≈ 6100 cfs.” (alteration added). Mr. Miller testified at trial that, “immediately before” he called in the order “to release more than 6000 cubic feet per second,” Mr. Miller had a

⁴⁰ Mr. Miller testified on cross-examination that, according to the Standard Operating Procedures, the storage capacity of Lake Estes does not have “a direct linear relationship” with water elevation, but rather a “curvilinear relationship,” and Mr. Miller allowed that it was “possible” his calculation of the 5.31 acre-feet increase was inaccurate.

conversation via phone call with Mr. Bailey, Ms. Ronca, and Mr. Thomasson, at which Mr. Miller recommended the increased release. Mr. Miller testified that he “and the other participants on the call were aware that at a flow of 6000 cubic feet per second, most structures in the Big Thompson Canyon below the [Olympus] dam would be inundated,” (alteration added), for which reason Mr. Miller held the phone conversation to discuss the potential release. Mr. Miller indicated, however, again supported by his contemporaneous notes, that the Bureau “shortly thereafter” revised its estimate of the total release based on measurements of Olympus Dam’s spillway gates to 5,280 cfs. Mr. Miller testified that the water schedulers had access to a computer system, referred to as “a SCADA,” an acronym which Mr. Miller did not define,⁴¹ which allowed the water schedulers to determine “how much the reservoir, you know, was going up, what it would take approximately to, you know, keep it [Lake Estes] from going above that, you know, 7474 [feet].” (alterations added). Mr. Miller stated that “we just, you know, made our -- our best, you know, guess at how much would cause the reservoir to start to, you know, stop rising and then start to -- start to decline, and we did exactly that.” Mr. Miller further testified that at 11:30 p.m. on September 12, “we had inflow forecasts that were very large” and that “we weren’t sure if the rain was going to continue, and we were getting very close to that threshold” of 7,474 feet. Moreover, Mr. Miller testified on cross-examination that he believed he was “not allowed to” increase the elevation of Lake Estes above 7,474 feet. Mr. VanShaar testified that “[a]s we understand and applied the SOP [Standard Operating Procedures], we would not have chosen to go above 7474.” (alterations added). Mr. VanShaar explained his view that “it was understood by my water schedulers that we would not choose to use that extra foot of capacity between 7474 and 7475 purposefully, meaning we would make decision that would keep from entering that” buffer space.

Mr. Miller testified that, while the water schedulers considered increasing flow through Olympus Tunnel in response to the water in Lake Estes approaching 7,474 feet in elevation, the water schedulers did not do so because of the “physical reason” that “[L]ittle Hells Canyon Diversion Dam was overtopping,” and that the Pole Hill Powerplant “couldn’t run because it was so plugged up with the strainers, and they were having difficulty getting personnel up to the plant to -- to get the plant running again.” (alteration added). Mr. Miller further clarified that Little Hells Canyon, where water from the Olympus Tunnel would be deposited, is only “a tiny little tributary” with “people’s property all along that,” such that sending additional floodwater “could be a very, you know, bad thing to do,” and moreover, “there’s nowhere ever [sic] does it say for our project to use flood control to send it down another tributary to get rid of the water.” (alteration added).

The Post Incident Analysis Report prepared by the Bureau contains an estimate and correction for the total release through Olympus Dam at approximately 11:30 p.m. on September 12, 2013, which is in line with the estimate and correction given by the Operating Log and Mr. Miller’s testimony. The Post Incident Analysis Report states at

⁴¹ At trial, Mr. Miller agreed with plaintiffs’ counsel’s characterization of the SCADA as “a computerized data acquisition system that collects the data in near realtime from the Bureau of Reclamation sensors” in Lake Estes. Mr. Miller further stated that the SCADA is “somehow connected to the Western Area Power Administration’s system,” but did not specify the nature of that connection.

11:32 p.m. on September 12: “Water keeps increasing into Lake Estes, now releasing 6,000cfs.” The Post Incident Analysis Report also states, however, that the “[p]ost-incident calculated release is 5,283cfs.” (alteration added). At trial, Mr. VanShaar testified that “the analysis after the fact tightened some of the estimates on the openings of the reservoir gates,” to produce the lower release figure of 5,283 cfs, while according to the parties’ joint stipulations, at the time of release Bureau personnel believed they were releasing “a flow greater than 6,000cfs.”

The Operating Log at 11:41 p.m. on September 12, 2013, states: “Received notification from Howard Bailey – notifying of releases from Oly Dam of 6000 cfs.” According to the parties’ joint stipulations, at 11:45 p.m. on September 12 peak inflow and peak release occurred simultaneously at Lake Estes and Olympus Dam, with inflows estimated to be between 5,391 and 5,395 cfs, and releases estimated to be between 5,280 and 5,377 cfs. The Post Incident Analysis Report states that “inflows into Lake Estes peaked between 4600 and 5300 cfs” at approximately “[j]ust prior to midnight,” and that “the release from Olympus Dam went as high as 5280 cfs,” which peak release “lasted less than two hours” before releases from Olympus Dam began to reduce. (alteration added).

According to the Lake Estes elevation data collected by the Bureau of Reclamation, after the increase in releases at 11:30 p.m. on September 12, 2013, the water elevation in Lake Estes began to drop, reaching 7,473.87 feet at 11:45 p.m. on September 12. There were no additional changes in releases after 11:30 p.m. on September 12 for approximately one and a half hours, until around 1:00 a.m. on September 13. During this period, releases from Olympus Dam continued at a consistent rate of approximately 5,280 cfs. According to the Lake Estes elevation data collected by the Bureau of Reclamation, at 11:45 p.m. on September 12 the Bureau was diverting 198 cfs through Olympus Tunnel. By 12:00 a.m. on September 13, the water elevation in Lake Estes dropped to 7,473.82 feet. At trial, Mr. Miller stated that he did not start reducing flows out of Olympus Dam at midnight on September 13 because “we weren’t sure if we were out of the woods” at that time. The water elevation in Lake Estes continued to lower, reducing to 7,473.75 feet at 12:15 a.m., and to 7,473.68 feet at 12:30 a.m. on September 13. Moreover, according to the Lake Estes elevation data collected by the Bureau of Reclamation, which was admitted as a joint exhibit, the water elevation in Lake Estes would continue to reduce until approximately 7:15 p.m. on September 13.

Mr. Miller testified, supported by his contemporaneous notes, that at approximately 1:00 a.m. on September 13, 2013, the Bureau reduced releases through Olympus Dam by 220 cfs, for a total release of 5,060 cfs, down from the revised peak release figure of 5,280 cfs. The Operating Log at 1:00 a.m. on September 13 states: “Oly Radial Gates #1 & #2 reduced by 4” [inches] each- per Miller, flow of ≈5000 cfs.” (alteration added). Mr. Miller testified that the amount by which the water schedulers decided to reduce outflows was not the result of a calculation, but rather reflected a desire to reduce outflows “slowly” because “we weren’t sure if there was more to come in and whatnot.” Mr. Miller further testified that “during that entire time period between 11:45 p.m. [September 12] and 2:00 a.m. [September 13],” there were releases “at or above 5000 cubic feet per second through the Olympus Dam.” (alterations added).

The Operating Log at 2:00 a.m. on September 13, 2013, states:

Per Miller, Oly Radial Gate # 1, 2 & 5 are @ 36" [inches] (-4"). Gate # 4 started to go closed per Lannis – he raised it back up & now can't get it to raise or lower (currently @ 39") – Electrician on his way to check situation ≈ 4425 cfs.

(alteration added). The Operating Log at 3:07 a.m., September 13, 2013, states: "Per Jonathan [Haywood]; Gate # 4 is now operational and open 36" [inches]. Breaker had tripped on overload." (alterations added).

According to an email sent by Mr. Lora to Ms. Ronca at 10:28 a.m. on September 13, 2013, Mr. Lora was back at his office and performing his duties as water scheduler by approximately 4:00 a.m. that morning. At 6:58 a.m. on September 13, Mr. Lora sent an email to Ms. Ronca stating that as of the morning of September 13, Olympus Dam had received 6.5 inches of rain in two days. The 6:58 a.m. email also stated, in relevant part:

3- Lake Estes release up to 5280 cfs last night, back down to 4,300 cfs. Reservoir level is dropping slowly. Current inflow is 4200.

4- Fate of Pole Hill's afterbay and Little Hells Canyon facilities unknown but suspected damaged.

5- Olympus Tunnel flow down to 190 cfs.

6- Signal from Dille Tunnel diversion structure and from the Canyon Mouth gage [sic] are lost.

7- Flatiron Powerplant still generating power. Unit #3 stopped pumping last night at 0100 hours (not enough water).

8- We are in priority to capture Big Thompson River water, but given the situation that is being done on a limited basis. Water is now been sent to Horsetooth.

(alteration added). The Operating Log at 7:00 a.m. on September 13, states: "BT [Big Thompson] crew reports BT PP [Powerplant] has taken on water." (alterations added). The Operating Log at 7:55 a.m. further states: "Received a call from Howard Bailey BT Below peak flow last night was 5280 cfs – current flow is 4200 cfs."

The Operating Log at 11:40 a.m. on September 13, 2013, states: "Oly Operator reports 4 Oly gts [sic] 30" [inches]." (alterations added). At 11:59 a.m. on September 13, Ms. Baty sent an email to Mr. Northrup, Mr. Beall, Mr. Bailey, Ms. Lamb, and thirteen others, who were not identified at trial, which stated that "Olympus Dam, Mary's [sic] Lake Dike, and East Portal Dam visual inspections today revealed no concerns. We maintain a R3 [Response Level 3] at Olympus [Dam] and still an Internal Alert at Mary's [sic] Lake, although the elevation has dropped below the trigger." (alterations added). The 11:59 a.m. email further states, in relevant part:

We have experienced damage to the [Little] Hell's Canyon Diversion Dam stoplogs, and flows through the Olympus Tunnel were reduced to 200 cfs, as a result. We have not since been able to get into that location to evaluate damage further. We are also restrict [sic] from being able to access Pole Hill powerplant right now.

The Big Thompson River is eroding around the concrete supports for the siphon that spans the River, carrying the Charles Hansen [sic] Feeder Canal flows to Horsetooth Reservoir.

(alterations added).

The Operating Log at 1:00 p.m. on September 13, 2013, includes two entries regarding Olympus Dam and Olympus Tunnel: "Per Lora Oly gts [sic] -3" [inches] = 27" (Gates (1, 2, 4 & 5))" and "Per Lora Oly Tunnel -100 = 100 cfs." (alterations added). The Operating Log at 2:00 p.m. on September 13 further states: "Per Lora Oly Tunnel -100 = 0 [cfs]." (alteration added). At 3:04 p.m. on September 13, Ms. Baty sent an email to Mr. Northrup, Mr. Beall, Mr. Bailey, Ms. Lamb, and thirteen others, which stated: "Once flows have subsided, we will be conducting thorough evaluations for damage at each site."⁴² The Operating Log at 3:34 p.m. on September 13 states: "Per Howard Bailey Big T [Thompson] River is at 2780 cfs." (alteration added).

Mr. Miller issued a water order in the afternoon of September 13, 2013, which appears to contain information for September 12 and 13, 2013, and did not contain prospective information for September 14, 2013. The September 13 water order appears to provide information regarding flow changes that occurred on September 12 noting "[m]aintain a flow of 75 cfs" with respect to releases from the Olympus Dam into the Big Thompson River, and "[m]aintain a flow of 550 cfs" with respect to Olympus Tunnel. (alterations added). The information for September 12 in the September 12 water order, however, appears to be identical to the information for September 11 and 12, 2013 included in the September 11 water order. Moreover, the September 13 water order states:

The inflow to Lake Estes has started to recede. Our current plan is to continue reducing the releases from Olympus Dam as the inflow recedes.

The Estes Powerplant will have 260 acre-feet of water scheduled for power generation on Friday [September 13]. Meanwhile, Flatiron units #1 and #2 will have 520 acre-feet available.

(alteration added). The September 13 water order, in its "summary of flow changes," further states:

⁴² Mr. Northrup testified at trial that he conducted the evaluation with respect to Olympus Dam.

Friday, 0100 hrs	Stop Flatiron Unit #3 Pumping to Carter Lake.
Friday, 0100 hrs	Adjust the Olympus dam release to the Big T [Thompson] river from 5280 cfs to 5060 cfs.
Friday, 0200 hrs	Adjust the Olympus Dam release to the Big T river from 5060 cfs to 4574 cfs.
Friday, 0300 hrs	Adjust the Olympus Dam release to the Big T river from 4574 cfs to 4425 cfs.
Friday, 0400 hrs	Adjust the Olympus Dam release to the Big T river from 4425 cfs to ___ [sic] cfs.

(alterations added). The September 13 water order further details flows for entirety of September 13, including the notations “[n]o flow” for the Big Thompson Powerplant and “[n]o generation” for the Pole Hill Powerplant, and the instruction to “[m]aintain a flow of 200 cfs” through the Olympus Tunnel. (alterations added).

The Operating Log at 5:48 p.m. on September 13, 2013, states: “Per Lora Oly gts [sic] -6” [inches] = 21” ea.” (alterations added). The Operating Log at 8:00 p.m. on September 13 further states: “Per Lora – if Lake Estes elevation reaches 7469.7’ [feet] – call Estes (Oly) and lower all gates #1, #2, #4, #5 -.25’ (current elev. 7469.78’).” (alteration added). The Operating Log at 8:53 p.m. on September 13 additionally states: “Oly Dam gates #1, #2, #4, #5 -.25’ [feet] verbal per Miller.” (alteration added). Seven minutes later, at 9:00 p.m. on September 13, the Operating Log further states: “Per L [Lora], Miller Oly Dam Rad [Radial] Gates #1, #2, #4, #5 @ 18” [inches] EA (-3” = .25’ [feet]).” (alterations added). The Operating Log at 11:10 p.m. on September 13 states: “Per Tim Miller – Oly Dam Rad [Radial] Gates #1, #2, #4, #5 +3” [inches] ea.” (alterations added). Five minutes later, at 11:15 p.m., the Operating Log further states: “Per L [Lora], Miller – Oly Dam Rad Gates #1, #2, #4, #5 to 21” = +3” ea.” (alteration added).

According to the parties’ joint stipulations, for an approximately 24-hour period from shortly before 12:00 a.m. on September 12, to shortly before 12:00 a.m. on September 13, 2013 the water coming into Lake Estes, including inflows, runoff, and rainfall, exceeded the water being released through the spillway gates of Olympus Dam, and as a result, the water elevation in the Lake Estes reservoir rose to 7,473.89 feet by 11:30 p.m. on September 12, the highest elevation which the reservoir would reach during the 2013 storm. The parties stipulated that at 11:30 a.m. on September 12, inflow into Lake Estes reached 3,903 cfs, while releases through the spillway gates amounted to 2,128 cfs, a difference of 1,775 cfs, the largest disparity between Lake Estes inflows and Olympus Dam releases documented during the September 2013 storm. Mr. Miller testified that he understood during the events of the September 2013 flood that water released from Olympus Dam would take approximately three to four hours to reach the mouth of the Big Thompson River Canyon downstream.

While the Bureau of Reclamation’s elevation gauge for the water in Lake Estes remained operational throughout the duration of the storm, the gauges relied on by the

Bureau to measure flow into Lake Estes and releases from Olympus Dam “washed out or became unreliable due to the intensity of the flow.” As a result, Bureau employees calculated inflows and releases according to “a mass-balance equation based upon the elevation level of Lake Estes and the opening of Olympus Dam’s spillway gates.”⁴³ Bureau employees did not constantly measure the spillway gate openings over the course of the storm, but the “water schedulers initially calculated certain inflows and releases based on the dam operators’ estimations of gate openings,” with such estimates being revised as measurements of the spillway gate openings were made. As a result, “the on-duty water scheduler initially believed, and the Bureau then adopted and reported, that peak release from Olympus Dam was a flow greater than 6,000cfs.” At the time of the September 2013 storm, according to the Bureau’s Standard Operating Procedures and Emergency Action Plan, and the parties’ joint stipulations, the Bureau understood that at a flow of 6,000 cfs, water would inundate structures in the Big Thompson River Canyon. When the spillway gate measurements for peak release were reported, estimates for peak release from Olympus Dam were revised to approximately 5,300 cfs.

The parties stipulated to four sources of water which contributed to the flow at the plaintiffs’ properties:

- (1) releases from Olympus Dam; (2) rainfall and runoff from the area between the dam and the confluence of the Big Thompson and North Fork Big Thompson Rivers at Drake; (3) the North Fork Big Thompson River; and (4) rainfall and runoff from the area between the confluence at Drake and Plaintiffs’ properties.

According to the parties’ joint stipulations, at the Orr property, peak flow of the Big Thompson River reached between 14,800 and 15,011 cfs, while peak flow by the Carman property reached between 14,800 and 15,080 cfs. The parties also stipulated that more than 9,400 cfs of the peak flow at plaintiffs’ properties are attributable to sources other than Olympus Dam releases.

According to the parties’ joint stipulations and the testimony of Mr. Carman, at approximately 11:00 a.m. on September 12, 2013, water from the Big Thompson River entered the basement of the Carmans’ home. The Carmans’ properties lost power “a little after lunch,” and between approximately 2:00 p.m. and 3:00 p.m., the Carmans lost phone service as well. At approximately 2:00 p.m., a “HUMV vehicle” arrived at the Carmans’ properties, and Mr. Carman spoke with one of the men from the vehicle and was left with the impression that the Carmans “were going to have high water,” but not that they needed to evacuate. By between 2:00 p.m. and 3:00 p.m., water from the Big Thompson River was flowing across the Carmans’ lawn between the river and their home. By the evening of September 12, 2013, the Carmans’ footbridge over the Big Thompson River had washed away. Mrs. Carman testified that by 6:00 p.m. on September 12, the water

⁴³ Mr. VanShaar testified that “on the evening of September 12, 2013, the estimated inflow to Lake Estes would have been calculated through mass balance principles. Inflows, whatever they are, all of them, minus outflows, that’s releases to the river and flows through the Olympus Tunnel, equals the change in storage.”

in the Carmans' basement had reached a depth of three to four feet. Mr. and Mrs. Carman testified that in the late afternoon or early evening of September 12, the Carmans went for a drive up the Big Thompson River Canyon as far as Drake and Waltonia, Colorado, and according to the testimonies of Mr. and Mrs. Carman, they did not see water on the road. Upon returning from this drive between approximately 6:30 p.m. and 7:00 p.m., according to Mr. Carman, the Carmans gathered a laptop and toiletries and relocated to their neighbor's house on higher ground across Highway 34 and did not see their property again until the next morning. When the Carmans last saw the water before departing their house, the water had risen to between a foot and a foot-and-a-half deep in the yard behind their house and the Indian Village store.

Between approximately 11:00 p.m. and 11:30 p.m. on September 12, 2013, Ms. Orr, who had been at her home for the entirety of the day of September 12, testified that she could no longer see the level of the river because of the darkness at that time of night, but the last time she had seen the river, "it wasn't anywhere close to the house," and remained in the grassy yard. At this time, Ms. Orr testified that she heard "a roaring sound of water coming down," which was different from earlier in the day, when the river had been quiet. At approximately 11:30 p.m. on September 12, the parties stipulated, and Ms. Orr testified, that Ms. Orr observed "the Big Thompson River rapidly rise out of its banks onto her property" and "overturn her picnic table, which had been set in concrete." In response, Ms. Orr evacuated her property to the house of two neighbors, the Swedlunds, and did not see her property again until the morning of September 13.

Mrs. Carman testified that at approximately midnight or 1:00 a.m. on September 13, 2013, she heard the river "rumbling and things rolling around the rocks." Mr. Carman further testified that between approximately midnight and 2:00 a.m. on September 13, he heard his backhoe, with its outriggers extended, dragging across concrete. Ms. Orr testified that at approximately 2:00 a.m. on September 13, while Ms. Orr could not see her house from the Swedlunds' property, she could hear "crackling" as well as "things coming down the river," and she "could smell propane." Ms. Orr testified that she could hear "noises during the entire night because of the water, the rush of the water hitting the boulders and things in the river that were bouncing against the boulders" as well as the crackling. According to the parties' joint stipulations, between approximately 3:00 a.m. and 4:00 a.m. on September 13, Mr. Carman "heard 'rocks rolling in the bottom of the creek'" which he attributed to erosion caused by the flooding.

Ms. Orr testified that she left the Swedlunds' house at approximately 5:30 a.m., September 13, 2013, and returned to her property, where she found, according to the parties' joint stipulations, "that the flood had eroded the banks of the Big Thompson River including the real property under and adjacent to her house, which had been damaged."⁴⁴

⁴⁴ Ms. Orr submitted a claim to the United States for the loss of her property by email on September 7, 2015. In the email, Ms. Orr stated that the portion of the house which fell into the river was lost at approximately 3:00 a.m. on September 13, 2013. At trial, Mr. Orr testified that the 3:00 a.m. time was only an estimation, and that she does not know what time the portion of the house collapsed.

At this time, the water had receded and the grassy lawn which previously fronted the river had washed away, while the portion of Ms. Orr's house nearest the river had collapsed into the river and much of the ground between the river and the house had eroded away, and the remainder of the house was left atop a ledge which Ms. Orr testified was approximately 20 feet high. Ms. Orr was evacuated by helicopter on September 15, 2013. As of the filing of plaintiffs' complaint in this court, Ms. Orr continues to own, and is able to visit, her property, and the Big Thompson River has not flooded Ms. Orr's property since the September 2013 flood.

According to the parties' joint stipulations and the testimony of Mr. Carman, by 8:00 a.m. on September 13, 2013, the Carmans saw that their store had washed away and water from the river was flowing behind and in front of their home, but the water was too high to reach the properties. The parties stipulated, and Mr. and Mrs. Carman testified, that at approximately 10:00 a.m. on September 13, Mr. and Mrs. Carman returned to their property and found the house still standing, along with their two horses in the fenced-in yard between a tree and the front door of the house. Mr. and Mrs. Carman attempted to get the horses out of the fenced-in yard by clearing debris blocking the horses' exit from the yard, however, a hole opened beneath the Carmans' home, into which the Carmans' horses and home fell and were lost. According to Mrs. Carman, when the hole opened up, Mr. Carman, who had been closer to the horses, "was standing about two feet from the bank," after the ground in front of him dropped away. Afterwards, the Carmans returned to their neighbor's house on higher ground.

According to their testimony at trial, Mr. and Mrs. Carman remained at their neighbor's house until September 14, 2013, when they were evacuated by helicopter at approximately 5:00 p.m. By the time of the Carmans' evacuation, water levels around the Carmans' properties had begun to recede. Upon returning to the properties approximately two weeks after the flood, Mr. Carman found that nothing remained of the store, and that only a portion of the floor, a piano, and a couch remained of the Carmans' home, as documented by pictures taken by Mr. Carman and admitted as joint exhibits at trial. Additionally, the S-shaped concrete wall, the Connex box, the horse trailer, and the corrals remained on the properties. Without their store, the Carmans could not afford to continue owning their properties, and the Carmans sold their properties to the Colorado Department of Transportation to replace a portion of Highway 34 lost in the flood, memorialized in a warranty deed dated August 19, 2016.⁴⁵ Subsequently, according to Mr. Carman's testimony and the parties' joint stipulations, the Carmans stayed with their daughter for a period of time, and ultimately moved to Cortez, Colorado. According to Mrs. Carman's testimony, the Carmans' property was not flooded again by the Big

⁴⁵ At trial, Mr. Carman testified that, after the September 2013 flood, the Carmans "couldn't afford to pay the taxes" assessed by Larimer County against their property, "and the State Highway come along and said we need to purchase that piece of property" in order "to put the highway there." Mr. Carman further testified that the Carmans accepted the offer to sell their land because otherwise the "county would have taken the property away from me."

Thompson River at any point between the September 2013 flood and when the Carmans sold the property in 2016.

Danger to Olympus Dam During the September 2013 Storm

With regard to dam failures, the parties' stipulations indicate that dam failures can lead to loss of life, and two modes of failure pose a risk to Olympus Dam: "(1) failure of the embankment dam from overtopping of its crest; and (2) sliding of the concrete gravity dam from high pool elevation levels or high flows." The parties' stipulations further indicate that "[o]vertopping of the embankment portion of Olympus Dam could result in severe erosion, breach, or failure." (alteration added). Witness testimony at trial additionally indicates that as a result of the Bureau of Reclamation's actions, Olympus Dam was not put in danger of a breach or of failing during the September 2013 storm. Mr. Beall testified that "lots of dams were in danger and lost during this event. So Olympus Dam was in peril, but we mitigated the risk through our actions" during the storm. Mr. Beall stated his understanding "that the event with huge flows at the peak of this storm coming into Lake Estes would have – obviously puts infrastructure in danger, and that's why we had to man it 24/7 and mitigate that danger by matching releases. Our lake elevation was at a safe level." At trial, at the prompting of plaintiffs' counsel on direct examination, Mr. Beall read from a portion of his earlier-given deposition testimony, in which Mr. Beall stated his belief that "[t]here was no emergency at Oly[mpus] Dam. The dam was not in danger. It's our job to protect the dam." (alterations added). Mr. Beall further read from his deposition a portion in which he stated, "in my opinion, the dam was never in jeopardy thanks to the actions we took." Mr. Beall also testified that during the event, he did not tell anyone "that the dam was in danger" during the September 2013 flood. Mr. VanShaar testified that "[a]t no time did we expect the dam to fail." (alteration added). Although she identified both a breach and overtopping of Olympus Dam as potential structural problems, Ms. O'Brien testified that during the September 2013 flood, she did not identify any structural problems at Olympus Dam aside from a broken gearbox which prevented the use of Gate 3.

As noted above, the Emergency Action Plan for Olympus Dam in effect at the time of the September 2013 flood provides for "Hazard Specific Guidelines" which specifically address operations during a flood event. At trial, Mr. Beall testified that an occurrence provided for in the "Hazard Specific Guidelines" for floods, a "sudden several foot rise in lake level," did not occur during the September 2013 flood. Mr. Beall further indicated in his testimony that the Emergency Action Plan did not require the Bureau of Reclamation to wait until the elevation in Lake Estes had reached 7,474 feet to begin opening Gate Number 3, or the applicable remotely-operated gate, and to wait until the elevation had reached 7,474.75 feet to begin opening the remaining gates. Rather, Mr. Beall stated, "I read this [the Hazard Specific Guidelines for floods] like you would a speed limit. Don't drive faster than 55, but you can drive 45. So it tells me I must do this at this point. It doesn't tell me I can't do it before." (alteration added). Mr. Beall was unable at trial to identify where in the Standard Operating Procedures, Emergency Action Plan, or other documents, were instructions for opening the spillway gates in an emergency situation before elevation reached 7,474 feet. In his testimony, Mr. Beall agreed that the intent of the Emergency Action Plan's Hazard Specific Guidelines for floods was to open the spillway gates "to an amount that won't allow the dam to overtop."

Mr. Beal further testified that the “priority of the Incident Management Team” was “to ensure the safety of the [Olympus] dam and to make sure it was not compromised,” to the exclusion of concerns such as electricity generation and water storage. (alteration added). Mr. Beall further testified that “making releases from Olympus Dam” was “part of the incident management’s [sic] team’s effort to ensure the structural integrity of Olympus Dam,” and stated, “[t]he dam positively would have overtopped,” if no releases were made during the September 2013 flood. (alterations added). According to the parties’ stipulations, the Incident Action Plan prepared by the Bureau on September 12, 2013, indicates that one objective of the Bureau’s response was “Priority to protect Olympus Dam which protects downstream property and lives.” At trial, Mr. Curtis testified that the Bureau of Reclamation “sustained damage below Olympus Dam, damage to the Dille Diversion Structure,” damage to the “support functions” of the “siphon that crosses the Big Thompson River,” “damage to the Big Thompson Powerplant, and to the outlet feature of the Pole Hill Powerplant,” and the power plants had to brought offline.

Mr. Beall testified that, after the September 2013 storm, he visited “Pole Hill, Hells Canyon, trifurcation [sic], Big Thompson Powerplant, Estes, [and] East Portal.” (alterations added). Mr. Beall stated that “[a]t the bottom of Little Hells Canyon, the water level had become so high that as it went over our timbers that I talked about before, it eroded out at downstream to rock.” (alteration added). Further, “the upstream portion had several feet of rock, mud, and debris, silt that had came [sic] down and settled in the bottom of Little Hells Canyon.” (alteration added). Mr. Beall testified that there was “[n]o damage at trifurcation except that siphon that transitions from the 930 [section] to the 550 [section] of the Charles Hansen Feeder” Canal, in particular damage to the supports of the siphon. (alterations added). Further, with respect to damage at the Big Thompson Powerplant, Mr. Beall testified that he was

[v]ery surprised to find out that the entire plant wasn’t flooded. We had some mud and water in the bottom. We have an external building that’s a battery room and some control equipment that had several feet of mud in it. We have an excitation transformer that’s mounted on top of the power plant deck that had lots of mud and debris.

A big log had poked a hole in the stairway that goes -- the siding of the enclosed stairway that goes down to the power plant. And then the other thing was the afterbay, where our water exits the power plant, was several feet of earthen soil.

(alteration added). Mr. Beall testified, however, that “shutting down the Olympus Tunnel” did not diminish the damage to the Big Thompson Powerplant, because “[t]his damage was due to the water at the mouth of the Big Thompson Canyon,” while similarly there was “no correlation” between the closing of the Olympus Tunnel and the damage to the Trifurcation. (alteration added).

Mr. Northrup testified that on September 17, 2013, he performed an inspection of Olympus Dam. According to an email Mr. Northrup sent at 12:34 p.m. the following day, September 18, 2013, to Ms. Baty, Mr. Northrup stated: “I walked Oly dam with Jon

Haywood. From visual inspection, the dam is in good condition. The water elevation at the time was 7470.53. Gate 1 was just closed, Releases were being made out of Gates 2,4,5.” Mr. Northrup testified at trial that, according to his inspection, “the dam had not shifted at all” during the September 2013 storm. Mr. Northrup further testified that he found “minimal erosion,” he was not “concerned with seepage” from the dam, that he found “no large or new cracks” in the dam, and that there were “no signs of stress from the storm” on the trunnion joints of the radial gates.

Mr. Northrup testified that his September 17, 2013 inspection of Olympus Dam was also documented by a formal report, which he sent to Mr. Pedersen. Mr. Northrup further testified that later, “more comprehensive reviews or inspections of the dam” had occurred, but those inspections “did not turn up any further problems that I may have missed.” At trial, when testifying to the findings of his inspection, Mr. Northrup stated that “[f]rom a dam safety perspective, we are comfortable with water under 7475.25” feet of elevation, and he clarified: “that refers to the first fill elevation, and we are comfortable with the dam’s performance of water on the structures up to that elevation.” (alteration added). Mr. Northrup further indicated, however, that while Olympus Dam had previously reached a first fill elevation of 7,475.25 feet without overtopping with all gates open, the water would begin to overtop the Olympus Dam gates at an elevation of 7,475 feet if the gates were closed, resulting in “[a]n uncontrolled reservoir release.” (alteration added). Mr. Northrup explained that “if the Bureau of Reclamation had a first fill condition at Olympus Dam during the September 2013 storm event, water would have overtopped the closed Gate 3,” because Gate 3 was closed for the duration of the storm.

At trial, Mr. VanShaar testified that “the primary goal” of the water schedulers “was to pass the large amount of flows that entered Lake Estes through the dam in a safe manner.” Mr. VanShaar testified that “from the very bottom of the regulatory storage” of Lake Estes, to an elevation of 7,474 feet, there is approximately 700 acre-feet of storage, while “approximately 1100 acre-feet” move through Lake Estes in a day when Olympus Dam is running at capacity. Mr. VanShaar further stated that during the storm he calculated that if inflows exceeded outflows by 1000 cfs, then a foot of regulatory storage in Lake Estes would be filled in one-and-a-half to two hours. Mr. VanShaar testified at trial that during the storm, he believed that without the Bureau of Reclamation making the releases that it did, Olympus Dam would have overtopped. Mr. VanShaar also stated, however, that during the storm he never “believed Olympus Dam was in danger,” nor did he “fear” that the dam would overtop, but this belief and lack of fear was due to the releases made from the dam by the Bureau of Reclamation, because the water schedulers “were following the standard operating procedures.”

At trial, Mr. VanShaar explained the Bureau’s unwillingness to let water enter the one-foot buffer as born out of concerns over uncertainty, stating: “We would not choose to use every last bit of storage space because nature could surprise us.” Mr. VanShaar stated that because the Bureau was receiving information regarding inflows to the dam and elevation, at most frequent, only every fifteen minutes, the water schedulers used the “buffer to absorb that uncertainty while we had a chance to then adjust for what we saw.”

Mr. Miller also testified to the reason the Bureau did not wait until the water in Lake Estes had reached an elevation of “7474 feet and a further release was indicated” before opening the radial gates beyond the amount that Gate 4 had been opened remotely:

going up to 75 [7,475] is only like 100 acre-feet or 150 acre-feet in that storage space, so it wouldn't have held hardly any of the water back. So the bigger concern was that if we got in a situation where we would start to overtop the gate -- so if we took it to 74 [7,474] and we got a sudden new influx of water from, you know, this rain event, it can very easily occupy that 150 or 180, whatever, acre-feet of space that's in that foot from 74 [7,474] to 75 [7,475].

(alterations added). Mr. Miller further clarified that the Bureau “didn't follow” the instructions in the Hazard Specific Guidelines to begin releases after reaching 7,474 feet in elevation, “because we didn't want the elevation to get above 74 [7,474].” (alteration added). Moreover, Mr. Miller testified on cross-examination that he was unaware of any policies that would have prevented the Bureau from releasing water in emergency circumstances before water had reached an elevation of 7,474 feet in Lake Estes.

Mr. VanShaar testified to the dangers of overtopping the radial gates of Olympus Dam:

The dam is constructed in such a way with a spillway upon which the five radial gates sit. The normal operation for water to go over the spillway then is for us to open those gates and allow water through the created orifice under the gates, immediately on top of the spillway. It's a smooth hydraulic transition. It allows the water to flow from a higher level of energy behind the dam, down along the spillway, to a lower level of energy in the river below. That's the way it's intended.

If water goes over the top of that, then there isn't that smooth hydraulic transition. It splashes down behind the gates, impacting the concrete spillway, subjecting it potentially to additional impact and abrasion and erosion, introducing a significant possibility for damage to the spillway. Compound that with the fact that on top of the reservoir is where much of the woody debris that comes along with flood waters collects, and you have the possibility of a log or some other piece of material flowing over the top and, again, impacting the concrete of the spillway, introducing the possibility of a crack or a break or a chip.

Once that occurs on a spillway, the smooth surface introduces friction and turbulence that tends to erode further, and it worsens the condition and the chance for destruction of the spillway.

Mr. VanShaar also indicated that the water schedulers believed that overtopping the gates would damage mechanical components “not intended to be submerged,” such as cables and stays.

At trial, Mr. Miller testified that the water schedulers considered the risk of overtopping the spillway gates to be “a bigger risk” than the size of the flows being released from the dam. In particular, Mr. Miller stated that the concern of the water schedulers was with regard to the unopened Gate 3:

So the concern was that if it -- if it started to overtop that gate, it could start to tear it or something, and then, you know, problems, and then you have an open bay if it were able to tear the gate through the flow over top of it and possibly start to damage, you know, the dam to where there's uncontrollable releases.

Mr. Northrup testified, somewhat differently than Mr. VanShaar and Mr. Miller, “that there was no way to know if the gates would definitely fail,” “if the elevation level rises higher than the top of” the Olympus Dam spillway gates.

The Post Incident Analysis Report prepared by the Bureau of Reclamation states under the heading “**What Went Well**,” with respect to the September 2013 flood:

Dam Safety: Dam facilities performed well and experienced only minor damage. Paula Baty in the Area Office and other Dam Safety personnel in the Region and Denver offices were readily accessible and provided technical advice, as needed throughout and after the event. Estes area personnel were knowledgeable of dam monitoring requirements and procedures, and conscientiously monitored all three facilities involved. Dam operators from other facilities were cognizant of potential structural issues and were readily responsive in supporting onsite personnel.

(capitalization and emphasis in original). The Post Incident Analysis Report further states in the section labeled “**Section 5. Conclusion:**”

Had the dam operator not made it to the dam when he did, and CCC [Casper Control Center] had not maximized their remote operating capability of the radial gates, empirical routings suggest the radial gates would have overtopped at 4:27 a.m. and the dam would have likely overtopped at 9:30 a.m. on the morning of September 12th.

(alteration added).

Paula O'Brien differentiated in her testimony between “danger” and “risk” to Olympus Dam during the September 2013 flood. Specifically, Ms. O'Brien defined danger as “something that is an active present tense, something is happening that is -- that is a problem right then and there.” Ms. O'Brien stated her belief that the dam “certainly has risk” of overtopping “if there's not a like response when we have high inflows.” Ms. O'Brien indicated in her testimony that, while “there's long-term risk through the event” of a breach or overtopping of the dam, she did not believe that Olympus Dam was in danger at 7:52 p.m. on September 12, 2013, when inflows to Lake Estes still exceeded outflows through Olympus Dam. Moreover, Ms. O'Brien continued to believe the dam was not in danger at approximately 1:14 a.m. on September 13, 2013, after the elevation of water in Lake

Estes began to reduce, although Ms. O'Brien maintained at that point that Olympus Dam was still "at risk." Ms. O'Brien asserted in her testimony that Olympus Dam "remained safe and performing well throughout the incident," although "[i]t was at varying degrees of risk throughout the event, varying degrees of overtopping risk throughout the event." (alteration added). In particular, Ms. O'Brien stated she agreed with the sentiment, expressed by Kara Lamb in an email dated September 13 at 12:08 p.m., that "Olympus Dam is SAFE." (capitalization in original).

Ms. O'Brien testified that "[d]uring the September 2013 flood event," the priority of the Olympus Dam Incident Management Team was "[p]ublic safety, and our role in that is preserving our high-risk structures, such as Olympus Dam." (alterations added). Ms. O'Brien further testified that "if there were no releases" by the Bureau during the storm, "the Olympus Dam radial gates would have overtopped." Ms. O'Brien elaborated:

Gate failure can happen multiple ways. It could wind up where we wouldn't be able to operate the gate, for example, if it were to -- for some reason those changes and forces caused that gate not to be able to operate to get -- it could fail entirely. If it were to fail entirely, there are a number of components that keep that gate in place and functioning, and any one of those could fail as a result of those forces changing both in the degree of those forces and increase in intensity over what they are normally and designed to be. So those are a few ways that that -- the gate could fail itself.

And if that gate fails, you can also -- if it were to fail entirely away from the structure, then you have a release of over 5000 cfs right there that does not stop until you lower -- until it basically empties the reservoir and you don't have any control over those flows.

Meanwhile, if the water were to come up high enough, then you wind up also having possible overtopping or the reserve flowing around other portions of the embankment where it's also not designed to withstand flows.

At trial, Mr. VanShaar stated his belief that the September 2013 storm was "unprecedented" because "[w]e had not had a multi-day storm with continuous, relatively low precipitation rate that continued for that many days." (alteration added). Mr. VanShaar further stated, with reference to the Senate Report on the C-BT Project admitted into evidence at trial, that the Bureau of Reclamation was "not operating the reservoir for purposes of preserving property downstream," although Mr. VanShaar indicated that at some points "we delayed changes in our releases to afford first responders additional time to convey the need for evacuations in the Big Thompson Canyon." According to the testimony of Mr. VanShaar, the operation of Olympus Dam did not deviate from the Standard Operating Procedures during the September 2013 storm.

During his testimony, Mr. VanShaar calculated the time it would take to fill the one-foot buffer space above 7,474 feet of elevation in Lake Estes, based on the information in the Olympus Dam Standard Operating Procedures. The Standard Operating Procedures Provide that at a water level elevation of 7,474, Lake Estes stores 2,477.8

acre-feet of water, while at an elevation of 7,469.5, the bottom of the regulatory pool, Lake Estes holds 1,735.5 acre-feet. At the top of the buffer space, 7,475 feet in elevation, Lake Estes has a storage capacity of 2,659 acre-feet. Accordingly, Mr. VanShaar testified that a change in elevation of five-and-a-half feet, from 7,469.5 feet to 7,475 feet, amounts to an addition of 923.5 acre-feet of water to Lake Estes, while a change in elevation of one foot from 7,474 feet to 7,475 feet, amounts to an addition of 181.2 acre-feet of water.⁴⁶ Based on this information from the Standard Operating Procedures, Mr. VanShaar calculated that the one-foot buffer would be filled in two-and-one-quarter hours if the inflow to Lake Estes exceeded the outflow by 1,000 cfs.

The parties stipulated that if Olympus Dam did not exist, the Olympus Tunnel would not exist either, and both the flow and debris held back by Olympus Dam and the flow and debris diverted into the Olympus Tunnel would have flowed down the Big Thompson River. At trial, Mr. VanShaar testified that, if the Olympus Dam were not present, the Bureau would not have been able to divert water away from flowing into the Big Thompson River, as it had through the Olympus Tunnel.

The parties disputed at trial whether the damage which occurred to plaintiffs' properties was the result, in part, of flows from the North Fork Big Thompson River, which joins the Big Thompson River at Drake, Colorado, upstream of plaintiffs' properties and which is not impacted by releases from Olympus Dam. At trial, Ms. O'Brien, who at the time of the September 2013 storm was a safety engineer at the East Colorado Area Office of the Bureau of Reclamation, testified that, at the time of the September 2013 flood event, she lived near Drake, "immediately upstream of the convergence," in a neighborhood on the North Fork Big Thompson River, and therefore not far from the location of Ms. Orr's property. Ms. O'Brien testified that during the storm, the bridge and roads near her home were damaged as a result of the North Fork Big Thompson River flooding, which caused the North Fork Big Thompson River to rise out of its banks and flow around the surrounding structures. Ms. O'Brien testified that she later learned through a National Resources Conservation Services report that flows in the North Fork Big Thompson River exceeded flows in the Big Thompson River during the September 2013 flood, in terms of cubic feet per second flow, although Ms. O'Brien clarified that she did not learn that until after the fact. Ms. O'Brien also testified to the degree to which floodwaters carried sediment and debris, and whether that would have added to the volume of flows. Ms. O'Brien testified that while she was unaware of "specific reports of sediment," she "recall[ed] having issues with sedimentation being deposited" by the floodwaters in the facilities generally, and stated that she "would assume it" because "that kind of rainfall event, you are going to have sedimentation problems." (alteration added). Ms. O'Brien further stated that when "the soil was saturated at that point after several days of rain, and when you have high-intensity rainfall or even low-intensity rainfall on saturated soil,

⁴⁶ The Standard Operating Procedures for Olympus Dam state at one point that a change in water elevation from 7,474 feet to 7,475 feet would amount to an increase of 182 acre-feet of storage. At another point, however, the Standard Operating Procedures provide the "active capacity" of the Lake Estes reservoir at each tenth of a foot in elevation, giving the storage at 7,474 feet as 2,477.8 acre-feet, and the storage at 7,475 feet as 2,659 acre-feet, a difference of 181.2 acre-feet.

it washes off the dirt, and the dirt goes downstream, which then goes into your reservoirs,” and Ms. O’Brien testified that “we did have significant sedimentation in Lake Estes” during the September 2013 storm.

The evidence in the record before the court includes an August 2014 report titled, “Hydrologic Evaluation of the Big Thompson Watershed” for the September 2013 flood, which states that it was prepared for the Colorado Department of Transportation by Jacobs Engineering Group. (the Colorado Department of Transportation 2014 Hydrology Report). The Colorado Department of Transportation 2014 Hydrology Report states that it contains analyses performed after the September 2013 storm, and that

[t]he purpose of the analyses is to ascertain the approximate magnitude of the September flood event in key locations throughout the watersheds and to prepare estimates of peak discharge that can serve to guide the design of permanent roadway and other infrastructure improvements along the impacted streams. These estimates of peak discharges for various return periods will be shared with local floodplain administrators for their consideration in revising or updating any current regulatory discharges.

(alteration added). The Colorado Department of Transportation 2014 Hydrology Report also states that “[p]rior to September 2013, the last major flooding event on the Big Thompson River upstream of Loveland was the infamous 1976 Big Thompson Flood.” (alteration added).

The Colorado Department of Transportation 2014 Hydrology Report indicates that, in December 2013, “[e]stimates of peak discharges associated with the September flood event based on field observations were undertaken by Bob Jarrett of Applied Weather Associates,” and states that “[t]he discharge estimates provided by Bob Jarrett, as well as any other available discharge estimates in the watersheds, were compared to the current regulatory discharges to provide an initial assessment of the relative magnitude of the September floods.” (alterations added). The discharge estimates developed by Bob Jarrett are also set forth in the appendices of the Colorado Department of Transportation 2014 Hydrology Report in a memorandum dated January 21, 2014, and revised July 16, 2014, which has the subject “**CDOT/CWCB Hydrology Investigation Phase One – 2013 Flood Peak Flow Determinations.**” (the Phase One Memorandum). (capitalization and emphasis in original). Further, the Colorado Department of Transportation 2014 Hydrology Report includes the results of Jacobs Engineering Group’s hydrologic model compared with the calculations by Bob Jarrett with respect to the September 2013 flood: the peak discharge from Olympus Dam during the September 2013 storm was calculated to be 5,327 cfs by both Jacobs Engineering Group and by Bob Jarrett. Peak flow at the confluence at Drake was calculated to be between 14,728 and 14,731 cfs by Jacobs Engineering Group, compared with 14,800 cfs by Bob Jarrett. The North Fork Big Thompson River peak flow at Drake was calculated to be between 7,706 and 7,723 cfs by Jacobs Engineering Group, compared with 5,900 cfs by Bob Jarrett. Peak flow in the Big Thompson River above Drake was calculated to be between 7,534 and 7,566 cfs by Jacobs Engineering Group, compared with 12,500 cfs by Bob Jarrett. The Colorado Department of Transportation 2014 Hydrology Report explained why the Jacobs

Engineering Group's calculated peaks did not match the Jarrett calculations by Bob Jarrett:

Downstream of Lake Estes, the calibrated model did not match the higher peak discharge estimates provided by Bob Jarrett (6,300cfs vs. 9,300 cfs at Loveland Heights and 7,600 cfs vs. 12,500 cfs at Mountain Shadows Lane). The primary reason the model did not match these peak discharges was because the model calibration in this reach was more heavily weighted to reflect the reliable Lake Estes discharge hydrograph. The relatively limited drainage area contributing runoff downstream of Lake Estes was insufficient to increase the peak discharges from the reservoir enough to match the other two estimates. However, further downstream, below the confluence with the North Fork Big Thompson at Drake, the calibrated model was able to match Bob Jarrett's estimate of 14,800 cfs within 1 percent.

DISCUSSION

Plaintiffs argue that the defendant's actions by employees of the Bureau of Reclamation during the September 2013 flood resulted in a taking of plaintiffs' properties by the defendant pursuant to the Fifth Amendment to the Constitution. The Takings Clause of the Fifth Amendment to the United States Constitution provides in pertinent part: "nor shall private property be taken for public use without just compensation." U.S. Const. amend. V. The purpose of this Fifth Amendment provision is to prevent the government from "forcing some people alone to bear public burdens which, in all fairness and justice, should be borne by the public as a whole." Ark. Game & Fish Comm'n v. United States, 568 U.S. 23, 31 (2012) (quoting Armstrong v. United States, 364 U.S. 40, 49 (1960)); see also Palazzolo v. Rhode Island, 533 U.S. 606, 618 (2001) (quoting Armstrong v. United States, 364 U.S. at 49), abrogated on other grounds by Lingle v. Chevron U.S.A. Inc., 544 U.S. 528 (2005)); Penn Cent. Transp. Co. v. City of New York, 438 U.S. 104, 123-24 (1978); Lingle v. Chevron U.S.A. Inc., 544 U.S. at 536; E. Enters. v. Apfel, 524 U.S. 498, 522 (1998); Pumpelly v. Green Bay & Miss. Canal Co., 80 U.S. (13 Wall.) 166, 179 (1871) (citing principles which establish that "private property may be taken for public uses when public necessity or utility requires" and that there is a "clear principle of natural equity that the individual whose property is thus sacrificed must be indemnified"); Reoforce, Inc. v. United States, 853 F.3d 1249, 1265 (Fed. Cir.), cert. denied, 138 S. Ct. 517 (2017); Rose Acre Farm, Inc. v. United States, 559 F.3d 1260, 1266 (Fed. Cir. 2009); Janowsky v. United States, 133 F.3d 888, 892 (Fed. Cir. 1998).

To succeed under the Fifth Amendment Takings Clause, a plaintiff has the burden of proof to demonstrate that the government took a private property interest for public use without just compensation. See St. Bernard Par. Gov't v. United States, 887 F.3d 1354, 1362 (Fed. Cir. 2018) ("It is well established that a takings plaintiff bears the burden of proof to establish that the government action caused the injury."); Dimare Fresh, Inc. v. United States, 808 F.3d 1301, 1306 (Fed. Cir. 2015) (stating that the "classic taking" is one in which the government directly appropriates private property for its own use (quoting Tahoe-Sierra Pres. Council, Inc. v. Tahoe Reg'l Planning Agency, 535 U.S. 302, 324 (2002))), cert. denied, 579 U.S. 902 (2016); Adams v. United States, 391 F.3d 1212,

1218 (Fed. Cir. 2004), cert. denied, 546 U.S. 811 (2005); Arbelaez v. United States, 94 Fed. Cl. 753, 762 (2010). The government must be operating in its sovereign rather than in its proprietary capacity when it initiates a taking. See St. Christopher Assocs., L.P. v. United States, 511 F.3d 1376, 1385 (Fed. Cir. 2008).

The United States Court of Appeals for the Federal Circuit has established a two-part test to determine whether government actions amount to a taking of private property under the Fifth Amendment. See Casitas Mun. Water Dist. v. United States, 708 F.3d 1340, 1348 (Fed. Cir. 2013); Klamath Irr. Dist. v. United States, 635 F.3d 505, 511 (Fed. Cir. 2011); Am. Pelagic Fishing Co., L.P. v. United States, 379 F.3d 1363, 1372 (Fed. Cir.) (citing M & J Coal Co. v. United States, 47 F.3d 1148, 1153-54 (Fed. Cir.), cert. denied, 516 U.S. 808 (1995)) reh'g en banc denied (Fed. Cir. 2004), cert. denied, 545 U.S. 1139 (2005). A court first determines whether a plaintiff possesses a cognizable property interest in the subject of the alleged taking. See Loretto v. Teleprompter Manhattan CATV Corp., 458 U.S. 419, 435 (1982) (citing United States v. Gen. Motors Corp., 323 U.S. 373 (1945)); see also McCutchen v. United States, 14 F.4th 1355, 1364 (Fed. Cir. 2021) (quoting Huntleigh USA Corp. v. United States, 525 F.3d 1370, 1377 (Fed. Cir.), cert. denied, (2008)); Welty v. United States, 926 F.3d 1319, 1323-24 (Fed. Cir. 2019) (“To maintain a cognizable claim for a Fifth Amendment taking, a plaintiff must establish that he possessed an enforceable property right.” (citing Lucas v. S.C. Coastal Council, 505 U.S. 1003, 1014-19 (1992))); Am. Pelagic Fishing Co., L.P. v. United States, 379 F.3d at 1372 (“It is axiomatic that only persons with a valid property interest at the time of the taking are entitled to compensation.” (quoting Wyatt v. United States, 271 F.3d 1090, 1096 (Fed. Cir. 2001), cert. denied, 535 U.S. 1077 (2002); and citing Cavin v. United States, 956 F.2d 1131, 1134 (Fed. Cir. 1992))); Air Pegasus of D.C., Inc. v. United States, 424 F.3d 1206, 1213 (Fed. Cir.) (stating that the court does not address the second step “without first identifying a cognizable property interest” (citing Am. Pelagic Fishing Co., L.P. v. United States, 379 F.3d at 1381; and Conti v. United States, 291 F.3d 1334, 1340 (Fed. Cir. 2002))), reh'g denied and reh'g en banc denied (Fed. Cir. 2005); Karuk Tribe of Cal. v. Ammon, 209 F.3d 1366, 1374-75 (Fed. Cir.), reh'g denied and en banc suggestion denied (Fed. Cir. 2000), cert. denied, 532 U.S. 941 (2001). “If the claimant fails to demonstrate the existence of a legally cognizable property interest, the courts [sic] task is at an end.” Am. Pelagic Fishing Co., L.P. v. United States, 379 F.3d at 1372 (citing Maritrans Inc. v. United States, 342 F.3d 1344, 1352 (Fed. Cir. 2003); and M & J Coal Co. v. United States, 47 F.3d at 1154); see also Hearts Bluff Game Ranch, Inc. v. United States, 669 F.3d 1326, 1329 (Fed. Cir.) (citing Am. Pelagic Fishing Co., L.P. v. United States, 379 F.3d at 1372), cert. denied, 567 U.S. 917 (2012).

In addition to “having identified a valid property interest, the court must determine whether the governmental action at issue amounted to a compensable taking of that property interest.” Huntleigh USA Corp. v. United States, 525 F.3d at 1378 (quoting Am. Pelagic Fishing Co., L.P. v. United States, 379 F.3d at 1372). In Arkansas Game & Fish Commission v. United States, the United States Supreme Court recognized five criteria relevant to analyzing whether government-induced flooding results in a compensable taking of a property interest. See Ark. Game & Fish Comm'n v. United States, 568 U.S. at 38-39. A Judge of the United States Court of Federal Claims summarized the Arkansas Game & Fish Commission criteria as a five-factor test that examines:

(1) time—the duration of the physical invasion; (2) causation; (3) intent or foreseeability, that is, “the degree to which the invasion is intended or is the foreseeable result of authorized government action;” (4) “the owner’s reasonable investment-backed expectations regarding the land’s use,” including “the character of the land;” and (5) the “[s]everity of the interference.”

In re Upstream Addicks & Barker (Texas) Flood-Control Reservoirs, 138 Fed. Cl. 658, 665 (2018) (quoting Ark. Game & Fish Comm’n v. United States, 568 U.S. at 38-39; and citing Ark. Game & Fish Comm’n v. United States, 736 F.3d 1364, 1369-75 (Fed. Cir. 2013)); see also Milton v. United States, 36 F.4th 1154, 1163 (Fed. Cir. 2022); St. Bernard Par. Gov’t v. United States, 887 F.3d at 1362; In re Upstream Addicks & Barker (Texas) Flood-Control Reservoirs, 146 Fed. Cl. 219, 249 (2019). With respect to causation, in cases where plaintiffs claim that flooding of their land is caused by the government’s operation of a dam, the Federal Circuit has explained that plaintiffs must show that the government’s “construction or operation of the [dam] subjected their lands to any additional flooding above what would have occurred in consequence of the severe . . . storm had defendant not constructed the [dam] at all.” St. Bernard Par. Gov’t v. United States, 887 F.3d at 1363 (alterations and ellipsis in original) (quoting Accardi v. United States, 220 Ct. Cl. 347, 358, 599 F.2d 423, 430 (1979)). In other words, “the causation analysis requires the plaintiff to establish what damage would have occurred without government action.” Id.

As jointly stipulated to by the parties, at the time of the September 2013 flood, Ms. Orr as well as Mr. and Mrs. Carman “owned property downstream of Olympus Dam, on the Big Thompson River in the Big Thompson River Canyon.” At issue in this Opinion is whether plaintiffs can demonstrate that the government’s operation of Olympus Dam during certain days in September 2013 caused a taking of plaintiffs’ properties when their properties were flooded. The United States Court of Appeals for the Federal Circuit in Ridge Line, Inc. v. United States, 346 F.3d 1346 (Fed. Cir. 2003), explained, in order to prevail on a claim for a taking by inverse condemnation, plaintiffs in this case “must establish that treatment under takings law, as opposed to tort law, is appropriate under the circumstances.”⁴⁷ Ridge Line, Inc. v. United States, 346 F.3d at 1355. The United

⁴⁷ Throughout the above captioned case, plaintiffs have inconsistently characterized the nature of their takings claims. In their complaint, plaintiffs alleged that “Defendant’s actions constituted a taking of property or inverse condemnation,” and that plaintiffs’ “damages included the loss of the use, occupancy, and enjoyment of the Plaintiffs’ homes and properties and the displacement or permanent removal or alteration of the Plaintiffs’ real property.” In their opening statement at trial, plaintiffs argued that government-induced flooding “resulted in the permanent taking of the property under their homes and businesses, and as a result, we believe that compensation is proper, proper [sic] under the takings law.” (alteration added). In their post-trial brief, however, plaintiffs argue, quoting In re Upstream Addicks & Barker (Texas) Flood-Control Reservoirs, 146 Fed. Cl. at 247 n.17, that plaintiffs

States Supreme Court, in Cedar Point Nursery v. Hassid, 141 S. Ct. 2063, addressed different forms of physical takings, stating in relevant part that “the government likewise effects a physical taking when it occupies property—say, by recurring flooding as a result of building a dam.” Id. at 2071 (citing United States v. Cress, 243 U.S. 316, 327-38 (1917)). The Supreme Court in Cedar Point Nursery further stated, “we have held that a physical appropriation is a taking whether it is permanent or temporary.” Id. at 2074. The Supreme Court explained that “our holding does nothing to efface the distinction between trespass and takings. Isolated physical invasion, not undertaken pursuant to a granted right of access, are properly assessed as individual torts rather than appropriations of a property right. This basic distinction is firmly grounded in our precedent.” Id. at 2078 (citing

“have alleged three separate takings: (1) a temporary, categorical, physical taking for the temporary flooding; (2) a permanent, categorical, physical taking for the destruction of plaintiffs’ personal property; and (3) a permanent, non-categorical, physical taking for the flowage easements on each property” resulting from the erosion of the riverbanks of the Orr and Carman properties and continued flow of the Big Thompson River over what was once property above the riverbanks.

At the closing argument, plaintiffs stated a different basis for their claims, that “the nature of the invasion was a permanent washing away of property. This was not a temporary taking or regulatory taking, but it is a physical taking.” While plaintiffs have articulated the nature of their alleged taking in multiple, inconsistent and mutually exclusive ways, their arguments in their briefs and before this court have reflected and concentrated on an application of the Supreme Court’s framework set forth in Arkansas Game & Fish Commission. As the Supreme Court explained in Cedar Point Nursery v. Hassid, the Arkansas Game & Fish Commission test is applicable in the context of temporary flood-induced takings. See Cedar Point Nursery v. Hassid, 141 S. Ct. 2063, 2079 (2021) (“Our approach in Arkansas Game and Fish Commission reflects nothing more than an application of the traditional trespass-versus-takings distinction to the unique considerations that accompany temporary flooding.”). Plaintiffs have not argued the application of the standards of permanent, physical takings to their claims in this court. See, e.g., Cedar Point Nursery v. Hassid, 141 S. Ct. at 2073 (“[W]e made clear that a permanent physical occupation constitutes a per se taking regardless whether it results in only a trivial economic loss.” (alteration added) (citing Loretto v. Teleprompter Manhattan CATV Corp., 458 U.S. at 423)); id. (“We reiterated that the appropriation of an easement constitutes a physical taking in Nollan v. California Coastal Commission.” (citing Nollan v. Cal. Coastal Comm’n, 483 U.S. 825, 828 (1987))); id. at 2075 (“The upshot of this line of precedent is that government-authorized invasions of property—whether done by plane, boat, cable, or beachcomber—are physical takings requiring just compensation.”). Because plaintiffs have argued their takings claims within the Arkansas Game & Fish Commission temporary, flood-induced takings analysis, and not under the permanent, physical takings analysis, and based on the evidence produced at trial, the court considers plaintiffs’ claims as for temporary, flood-induced takings of the Orr and Carman properties.

Portsmouth Harbor Land & Hotel Co. v. United States, 260 U.S. 327, 329-30 (1922)). Moreover, the Supreme Court explained:

The distinction between trespass and takings accounts for our treatment of temporary government-induced flooding in Arkansas Game and Fish Commission v. United States, 568 U.S. 23, 133 S. Ct. 511, 184 L. Ed. 2d 417 (2012). There we held, “simply and only” that such flooding “gains no automatic exemption from Takings Clause inspection.” Id., at 38, 133 S. Ct. 511. Because this type of flooding can present complex questions of causation, we instructed lower courts evaluating takings claims based on temporary flooding to consider a range of factors including the duration of the invasion, the degree to which it was intended or foreseeable, and the character of the land at issue. Id., at 38-39, 133 S. Ct. 511. Applying those factors on remand, the Federal Circuit concluded that the government had effected a taking in the form of a temporary flowage easement. Arkansas Game and Fish Comm’n v. United States, 736 F.3d 1364, 1372 (2013). Our approach in Arkansas Game and Fish Commission reflects nothing more than an application of the traditional trespass-versus-takings distinction to the unique considerations that accompany temporary flooding.

Cedar Point Nursery v. Hassid, 141 S. Ct. at 2078-79. Based on the Supreme Court’s analysis in Cedar Point Nursery, an application of the Arkansas Game & Fish Commission factors to the above captioned case determines whether plaintiffs’ claims for just compensation based on the flooding of their properties sound in tort or in takings.

Causation

Plaintiffs, Ms. Orr and Mr. and Mrs. Carman, acknowledging plaintiffs’ burden to prove a taking, cite to the Federal Circuit’s decision in St. Bernard Parish Government v. United States, 887 F.3d 1354, to argue that “Plaintiffs must show that, ‘in the ordinary course of events, absent government action, plaintiffs would not have suffered the injury.’” (quoting St. Bernard Par. Gov’t v. United States, 887 F.3d at 1362). Plaintiffs refer to the instruction in St. Bernard Parish, that “with respect to flooding during severe storms in cases involving a dam, a plaintiff must demonstrate that he or she suffered ‘additional flooding above what would have occurred in consequence of the severe . . . storm had defendant not constructed the [dam] at all.’” (alteration and ellipsis in original) (quoting St. Bernard Par. Gov’t v. United States, 887 F.3d at 1363 (internal quotations omitted)). Plaintiffs acknowledge that the “totality of the government’s actions” must be considered,” including actions by the government “that might have mitigated” damage to plaintiffs’ properties. (citing St. Bernard Par. Gov’t v. United States, 887 F.3d at 1364, 1367). Plaintiffs, nevertheless, assert that the damage to, and loss of use of, Ms. Orr’s and the Carmans’ properties “more probably than not resulted from the Bureau’s decisions and actions to protect its facilities during the 2013 storm event, its storage of water of September 12, and its releases of storage flows from the Olympus Dam during the night and early morning of September 12-13, 2013.”

Defendant, however, argues that “it did not cause the flooding and erosion of Plaintiffs’ properties,” and that the United States is entitled to judgment in its favor. Defendant relies on the same standards cited by plaintiffs from the same St. Bernard Parish decision of the Federal Circuit, and argues that “[t]o demonstrate causation a plaintiff must show what would have happened if the government had not acted,” (alteration added), in particular, “Plaintiffs must show that they suffered ‘additional flooding above what would have occurred in consequence of the severe . . . storm had defendant not constructed the [dam] at all.’” (alteration and ellipsis in original) (quoting St. Bernard Par. Gov’t v. United States, 887 F.3d at 1363 (internal quotations omitted)).

In addition to the fact witnesses who appeared at trial, plaintiffs offered the testimony of two experts, Mr. L. Clint Brown and Mr. Noel Potter, while defendant also offered the testimony of two experts, Dr. George F. McMahon and Dr. David S. Bowles. Plaintiffs’ first expert, Mr. Brown, was accepted by the court as an expert in the fields of hydrology, hydraulics, dam safety, and dam and reservoir operations. Plaintiffs’ second expert, Mr. Potter, was accepted by the court as an expert in the field of land surveying. Defendant’s first expert, Dr. McMahon, was accepted by the court as an expert in the fields of hydraulics, hydrology, and dam reservoir operations. Defendant’s second expert, Dr. Bowles, was accepted by the court as an expert in the fields of flood hydrology, reservoir operations, and dam safety.

Plaintiffs’ expert Mr. Brown prepared an “**Engineer’s Opinion Report**,” dated January 2021, and a revised version in February 2021. (capitalization and emphasis in original). Mr. Brown testified that the data he relied on to produce his opinion was provided by the Bureau of Reclamation. Mr. Brown’s expert report indicates that Mr. Brown’s firm, Engineering Analytics, Inc.,⁴⁸ was “retained by Burg Simpson [plaintiffs’ counsel] to evaluate how operations of Olympus Dam may have contributed to the damage” at plaintiffs’ properties. (alteration added). According to his expert report, Mr. Brown relied on data from the Bureau of Reclamation regarding Olympus Dam water releases, which data was identified as the “‘*revised release*’ dataset” by Mr. Brown. (emphasis in original). Mr. Brown performed a hydraulic analysis, which according to his expert report “consists of a water balance for Olympus Dam/Lake Estes and a hydraulic model of the Big Thompson River with a focus on the three properties.” Mr. Brown listed “general assumptions” of the hydraulic analysis, including “[b]ulking factors of the flow” which “varied between 1.1 and 2.0.” (alteration added). His expert report states: “The observed/estimated peak flows accounted for bulking, but the flows released from Olympus did not account for bulking that would occur just downstream.” With the Olympus Dam release data and the assumptions, Mr. Brown’s expert report indicates that Mr. Brown conducted “water balance calculations,” explained as follows:

The Olympus Dam water balance accounts for inflows, outflows, and changes in storage in Lake Estes. The purpose of the water balance was to

⁴⁸ Mr. Brown identified himself in his expert report as “a Civil/Geotechnical Engineer,” and stated that he is “currently the Senior Dam and Reservoir Engineer, and a Vice President at Engineering Analytics, Inc., a consulting engineering company in Fort Collins, Colorado.”

determine: 1) how much flow was released from Olympus Dam into the Big Thompson River and 2) if releases into the Big Thompson River were greater than inflows.

Mr. Brown relied on the estimates of the peak flows during the September 2013 storm set forth in the “Phase One Memorandum,” calculated by Bob Jarrett, which was included with the Colorado Department of Transportation 2014 Hydrology Report prepared by the Jacobs Engineering Group, rather than the Colorado Department of Transportation 2014 Hydrology Report. The peak flows used by Mr. Brown were 5,900 cfs in the North Fork Big Thompson River at Drake, 12,500 cfs in the Big Thompson River at Drake, 14,800 cfs below Drake and after the confluence with the North Fork Big Thompson River, and 15,500 cfs further downstream, below the mouth of the Big Thompson River Canyon. Of these estimated peak flows, Mr. Brown estimated the 14,800 cfs flow of the Big Thompson River below Drake to be the peak flow at plaintiffs’ properties, because plaintiffs’ properties were no more than approximately two and a half miles downstream of Drake, and “[l]ittle to no attenuation of the peak flow of 14,800 cfs is anticipated between the Big Thompson below Drake location and the damaged properties.” (alteration added).

Mr. Brown also addressed in his expert report the impact of “bulking” on the water released from Olympus Dam, which he explained as the tendency that “the water will pick up sediment, boulders, trees and other debris. The additional volume of sediment, boulders, trees, and other debris will result in increased volume in flow.” In his expert report, Mr. Brown indicated that the peak flows he used from the Phase One Memorandum of the Colorado Department of Transportation 2014 Hydrology Report “already include the bulking factor” because “by the time the water released from the dam traveled to the properties in question the released flows had picked up sediment and debris in the canyon.” In the results of his hydraulic analysis, Mr. Brown stated that peak release from Olympus Dam occurred at 11:45 p.m., September 12, 2013, at which time a rate of 5,377 cfs was released into the Big Thompson River. Mr. Brown further determined “that the flows released from Olympus Dam into the Big Thompson River arrived at the properties between 1.2 and 2.0 hours after release,” such that “Olympus Dam’s peak ‘revised release’ of 5377 cfs at 23:45 on September 12 would have reached the properties between approximately 1:00 and 1:45 on September 13.” (emphasis in original).

Mr. Brown calculated that 722 cfs of stored water was released into the Big Thompson River during the peak release from Olympus Dam, and Mr. Brown termed this portion of the peak flow “storage flow.” Mr. Brown applied three bulking factors, 1.1, 1.6, and 2.0,⁴⁹ to this 722 cfs storage flow figure, producing “bulked storage flows” of 794, 1,155, and 1,444 cfs, respectively. Mr. Brown subtracted from the peak flow of 14,800 cfs at plaintiffs’ properties, which produced “theoretical peak flows” of 14,006, 13,645, and

⁴⁹ Mr. Brown explained in his expert report that “[b]ulking has been found to range between 1.1 and 1.6 for the rivers that were studied by WEST Consultants, Inc.,” and that “Gusman et al. (2009) summarize a variety of California county bulking factor guidelines or requirements, where counties suggest a bulking factor as high as 2.0 for design.” (alteration added).

13,356 cfs, respectively, each of which Mr. Brown explained “represents the estimated peak flow at the properties if the Olympus Dam had released outflows in the Big Thompson River that were equal to watershed inflows.” Mr. Brown’s expert report further indicates that Mr. Brown employed an “HEC-RAS [Hydrologic Engineering Center-River Analysis System] mode” in order “to determine the depths of flow at cross-sections that represent the three damaged properties” and to “determine the increase in the depth, due to storage releases of Olympus Dam.” (alteration added). Mr. Brown calculated that at the Orr property, “[t]he difference in depth between the actual peak flow depth and the theoretical peak flow depth ranges from 0.24 to 0.54 feet,” that at the northern portion of the Carman property, the difference in depth “range [sic] from 0.27 to 0.52 feet,” and that at the southern portion of the Carman property, the difference in depth “ranges from 0.30 to 0.55 feet,” with higher bulking factors producing a greater difference in depth at each property. (alterations added). Mr. Brown explained in his expert report:

Increases in flood depth result in an increased pore pressure of the foundation soils, decreased soil stability, and increased erosion potential. As the depth of water increases, water pressures decrease the effective stress in the soil particles. As effective stress in the soil particles decrease, the soil becomes less stable and more susceptible to erosion. The increase in erosive potential due to increases in flow depth more probably than not resulted in increased damage and loss of land at the three properties. The resulting decreases in effective stress in the foundation soils beneath the properties more probably than not contributed to foundation movement and potential loss of structure.

Following the hydraulic analysis, Mr. Brown offered “conclusions and opinions,” including that “Storage Flow releases into the Big Thompson River exceeded the expected river flows by as much as 722 cfs during the estimated time that the houses were initially damaged and by as much as 868 cfs during the event.” (capitalization in original). Mr. Brown also concluded:

The storage releases from Olympus Dam were lower than flows from the Big Thompson River and North Fork of the Big Thomson River watershed. Additionally, Lake Estes storage releases into the Big Thompson River would not by themselves cause flooding of the properties. Moreover, due to the extreme nature of the 2013 event flooding of the properties may have occurred, however the timing (starting at the peak of flows) and duration (18.5 hours) more probably than not that the Lake Estes storage releases would have been “the straw that broke the camel’s back.”

As noted above, plaintiffs’ second expert witness was Mr. Noel Potter, who testified that he is a land surveyor and “president of CCS Consultants, Incorporated, a surveying firm.” Mr. Potter prepared graphics representing Ms. Orr’s property before and after the September 2013 flood, which graphics were admitted at trial as evidence without objection. Mr. Potter testified that he did not visit Ms. Orr’s property to make the graphics, but rather used “an image from Google Earth,” dated 2012, for the pre-2013 flood image. A document titled, “**EXPLANATION OF ELIZABETH ORR FLOOD GRAPHICS**,”

prepared by Mr. Potter and admitted as an exhibit in the record, indicates that an image of Google Earth, dated 2019, also was used for the post-2013 flood image. (capitalization and emphasis in original). Mr. Potter testified that he superimposed the lines of Ms. Orr's property on the images based on the plat of the subdivision in which Ms. Orr's property is located. Mr. Potter also testified that he estimated the shoreline of the Big Thompson River with respect to Ms. Orr's property and marked the centerline of the river, which formed one boundary of Ms. Orr's property. On the graphic depicting Ms. Orr's property before the September 2013 flood, Mr. Potter imposed text which reads: "PRE 2013 FLOOD APPROXIMATELY 0.14 ACRES IN THE RIVER." (capitalization in original). On the graphic depicting Ms. Orr's property after the September 2013 flood, Mr. Potter imposed text which reads: "POST 2013 FLOOD APPROXIMATELY 0.77 ACRES IN THE RIVER AREA." (capitalization in original). At the bottom of both Mr. Potter's pre- and post-September 2013 flood graphics, Mr. Potter included, "NOTE: THIS EXHIBIT DOES NOT REPRESENT A MONUMENTED LAND SURVEY. IT IS INTENDED ONLY AS A GRAPHIC DEPICITION OF THE ATTACHED DESCRIPTION," (capitalization in original), and Mr. Potter explained at trial: "That's included because I did not perform any field survey to prepare this graphic." Mr. Potter testified that it was his "opinion that these graphics represent, to a reasonable degree of certainty, the pre- and post-flood acreage of Ms. Libby Orr's property." Mr. Potter did not produce a similar graphic of the Carmans' property before and after the September 2013 flood, and plaintiffs did not provide a separate expert to analyze the Carman property.

Defendant's first expert witness was Dr. George McMahon, who testified that he holds a Ph.D. "in water and environmental engineering and with a minor in economics and public policy." Dr. McMahon testified that he works for Arcadis U.S., Inc., as a vice president and as a national expert in water management, which Dr. McMahon testified "means I basically get involved in projects all over the world providing technical support, technical oversight, quality assurance, quality control, and also business development in these areas." Dr. McMahon prepared an expert report for defendant, titled "Analysis of the Big Thompson River Flood of September 2013," dated January 2021. Dr. McMahon's expert report states that Dr. McMahon sought to determine "the extent to which Olympus Dam releases during the September 2013 flood may have contributed to flooding of the Orr and Carman (Plaintiffs) properties." Dr. McMahon's expert report explains that "[d]etermination of river stages and flow velocities attributable to spillway releases required comparison of actual spillway releases (regulated flow scenario) with alternative flow scenarios." Dr. McMahon considered two alternatives, "[p]erfect' reservoir operation, with spillway releases exactly equal to net Olympus reservoir inflows after accounting for Adams Tunnel inflows to and Olympus Tunnel diversions from the reservoir (unregulated flow scenario)," and "[n]atural flow at the site of Olympus Dam assuming the dam, reservoir, Adams Tunnel, and Olympus Tunnel did not exist (unimpaired flow scenario)." (alterations added).

According to his expert report, Dr. McMahon's methodology was to "[v]erify" the Bureau of Reclamation's "Olympus Dam inflow and outflow calculations during the event;" to "[d]erive unimpaired (naturalized) inflows at Olympus dam site," to "[d]evelop a simplified HEC-HMS (Hydrologic Modeling System) model" to estimate "flood hydrographs at Plaintiffs' properties based on rainfall-runoff simulation, combining and

routing of Olympus Dam flows to the Carman (the most downstream) property,” and to “[d]evelop a steady-flow HEC-RAS (River Analysis System) model” to compare “peak flood stages and flow velocities at Plaintiffs’ properties computed based on Colorado Department of Transportation (CDOT) and Arcadis hydrologic model results.” (alterations added). Dr. McMahon determined peak flow to occur at the Olympus Dam location at 11:45 p.m., September 12, 2013, for all three scenarios, the actual “regulated flow” scenario and the hypothetical “unregulated flow” and “unimpaired flow” scenarios. Dr. McMahon calculated the peak flow of each scenario: 5,283 cfs for regulated flow, 5,173 cfs for unregulated flow, and 5,385 cfs for unimpaired flow. Dr. McMahon further calculated the peak flow of the North Fork Big Thompson River, 7,777 cfs at 1:00 a.m., September 13, 2013, and from these calculations, he determined the time and rate of peak flow at plaintiffs’ properties under each of the three scenarios.

Dr. McMahon calculated peak flow to have occurred at 12:45 a.m., September 13, at the Orr property, at a rate of 15,011 cfs under the regulated flow, 14,943 cfs under unregulated flow, and 15,108 under the unimpaired flow. At the Carman property, Dr. McMahon calculated peak flow to occur at 1:00 a.m., September 13, at a rate of 15,080 cfs under regulated flow, 15,016 cfs under unregulated flow, and 15,185 cfs under unimpaired flow. Dr. McMahon’s expert report records as his “observations,” that “[f]or all scenarios, the largest component of peak flow at the Orr and Carman properties is runoff from the North Fork Basin” and that peak flow from the Olympus Dam location arrives at the confluence of the Big Thompson River and the North Fork Big Thompson River, immediately upstream of plaintiffs’ properties, “1.5 hours or more after peak flow at Plaintiffs’ properties (both of which occur less than 15 minutes apart).”⁵⁰ (alteration added). Dr. McMahon’s expert report also indicates the effect of the calculated flows on the flow depth at plaintiffs’ properties, stating,

in the unimpaired Olympus Dam flow scenario, duration of flows above 10,000 cfs at both properties increases by about an hour, and above 14,000 cfs by about 30 minutes in comparison to the unregulated scenario. This result suggests that, without Olympus Dam in operation, bank erosion and undermining of structural foundations on the properties would have persisted longer and could have caused more damage than was experienced during the flood.

⁵⁰ Dr. McMahon’s expert report restates this calculation elsewhere as “[p]eak flow from Olympus Dam does not arrive until 1.5 to 2 hours after the Big Thompson River crests at the [plaintiffs’] properties.” (alterations added). As noted above, Dr. McMahon calculated peak flow as occurring at the Orr property at 12:45 a.m. on September 13, 2013, and at the Carman property at 1:00 a.m. on September 13, 2013. According to Dr. McMahon’s calculations, therefore, peak release from Olympus Dam did not arrive until at the earliest at 2:15 a.m., at the Orr property, and 2:30 a.m., at the Carman property. Plaintiffs’ expert Mr. Brown, by contrast, calculated that peak release from Olympus Dam “arrived at the [plaintiffs’] properties between 1.2 and 2.0 hours after release,” (alteration added), or between approximately 1:00 a.m. and 1:45 a.m. on September 13, 2013.

Dr. McMahon's expert report includes his finding that "flow time series and flow-duration data generated by the HEC-HMS [Hydrologic Modeling System] model indicate that Olympus Dam as operated may have reduced peak flows, duration of high flows, and potential flood damages to Plaintiffs' properties in comparison to those that would have naturally occurred without the dam." (alteration added). In Dr. McMahon's expert opinion,

the September 2013 flood was an extreme event that would have damaged Plaintiffs' properties in much the same fashion as they had been, no matter how closely spillway releases from Olympus Dam matched inflows to the reservoir, or how Adams Tunnel inflows and Olympus Tunnel diversions had been managed. Had Olympus Dam been operated such that spillway releases did not closely match inflows, overtopping and dam failure could potentially have resulted, causing even greater flood damages than had occurred and possible loss of life downstream in addition. Lastly, the unimpaired flow scenario demonstrates that Plaintiffs would have been worse off had Olympus Dam and tunnels not been in operation at the time.

Defendant's second expert witness, Dr. David Bowles, testified at trial that he has a Ph.D. in civil and environmental engineering, with a focus on water resources and hydrology. Dr. Bowles also testified that he is a licensed professional engineer and the owner and managing principal of RAC Engineers and Economists, LLC. Dr. Bowles produced an expert report which provides his "opinions on the effects on dam safety had the Bureau of Reclamation deviated from its operating rules by limiting releases from the Olympus Dam during the flood event that commenced on September 12, 2013." Dr. Bowles' expert report states:

I was asked to evaluate the following three hypothetical cases of limiting spillway releases from Lake Estes throughout the September 2013 flood event, starting at the time that the operator arrived at Olympus Dam at about 2:15 am on September 12, 2013, as follows:

1. Limited by a constant 2.50-foot opening of a single spillway gate, which is the maximum opening for remote operation with no operator physically present at Olympus Dam.
2. Limited to a constant 1.61-foot opening of a single spillway gate, which corresponds to the flow rate of 653 cubic feet per second (cfs), estimated by Arcadis at the time that the operator arrived at Olympus Dam at about 2:15 am on September 12, 2013.
3. Limited by all spillway gates remaining closed, which eliminates any release into the Big Thompson River.

Dr. Bowles' report indicates that Dr. Bowles performed a "reservoir routing" analysis to evaluate the hypotheticals, and the report explains: "reservoir routing involves adding inflows and subtracting releases from the starting storage volume to calculate the ending storage volume," which can be used to determine the water surface elevation of the reservoir according to the "elevation-capacity relationship." Dr. Bowles' analysis

determined that, for the first hypothetical, “[t]he estimated peak reservoir water surface elevation is 7,482.5 feet,” with the following effects:

- a. Overtopping of the left abutment starting at Elevation 7481.2 feet for almost a day, resulting in a significant flow down the groin at the left abutment with the potential to initiate an erosional failure of the embankment dam.
- b. Exceeding the elevation of 7478 feet for more than three and one-half days, which is reported by Reclamation (2009, US_0076981) to be the threshold elevation for a sliding failure of the concrete gravity dam.
- c. Overtopping of the spillway gates at Elevation 7475 feet for almost five days, which, consistent with other dams, is specifically prohibited by Reclamation (2016, US_0077436) because this could damage the gates and possibly lead to a structural failure of the gates.
- d. Overtopping of the parapet wall on the concrete gravity dam on both sides of the spillway starting at Elevation 7481.9 feet for about half a day with the potential to initiate an erosional failure of the right end of the embankment dam.

. . .

- e. Overtopping of the downstream curb on the bridge over the concrete gravity spillway starting at Elevation 7478.75 feet for more than two and one-half days, resulting in flow over the right end of the embankment dam, which could initiate an erosional failure of this dam.
- f. Overtopping of the right abutment starting at Elevation 7481.9 feet for about half a day.

(ellipsis added). Dr. Bowles found the same results with respect to the second and third hypotheticals as he did for the first hypothetical, except that the duration of each result was longer. For the second hypothetical, Dr. Bowles’ expert report indicates that the left abutment would overtop “for almost one and a half days,” the elevation threshold of 7,478 feet would be exceeded “for more than five days,” the spillway gates would overtop “for more than six days,” the parapet wall would overtop “for more than half a day,” the downstream curb on the bridge would overtop “for more than four and one-half days,” and the right abutment would overtop “for more than half a day.” For the third hypothetical, Dr. Bowles’ expert report indicates that the left abutment would overtop “for about two and one-half days,” the elevation threshold of 7,478 feet would be exceeded “for well over six days,” the spillway gates would overtop “for well over six days,” the parapet wall would overtop “for more than one and one-half days,” the downstream curb on the bridge would overtop “for well over six days,” and the right abutment would overtop “for more than one and one-half days.” Dr. Bowles’ report concludes with Dr. Bowles’ opinion that all three hypotheticals “should be avoided if possible” because they “have the potential to lead to a failure of Olympus Dam as a result of overtopping or exceeding the sliding stability threshold,” which “would result in a sudden and life-threatening breach wave with a peak discharge rate many times higher than the peak release that actually occurred.”

Based on the conclusions of plaintiffs' expert witness Mr. Brown, plaintiffs argue "that the increased storage flows caused by Olympus Dam (compared to if Olympus Dam was not present) was sufficient to cause the damage to Plaintiffs' property." (alteration added). According to plaintiffs, Mr. Brown's conclusions "were based on a reasonable probability that the combination of the Olympus Dam storage flows plus natural flows caused the damage," such that the water stored "during the day of September 12-13, 2013," when released, "increased and elongated the peak and erosive flows of the Big Thompson River" at plaintiffs' properties. According to plaintiffs, Mr. Brown's testimony indicated that water flowing into Lake Estes deposited any sediment it was carrying into the reservoir, and "bulking" occurred as the Bureau released clean, 'sediment-starved' water from the Olympus Dam and the water (described by Mr. Brown as 'release flows' and 'storage flows,') picked up sediment, boulders, and debris as it [the water] flowed over several miles through the Big Thompson Canyon toward the plaintiffs' property." (alteration added). Plaintiffs argue that "[t]he bulking of the water increased the depth and velocity of the flood water flowing through the canyon over the night of September 12-13, 2013," while "had there been no Olympus Dam, the water passing through where Lake Estes is impounded would already have been bulked," such that "for instance, 5000cfs flowing through would have essentially the same volume as it flowed through the canyon," while the same amount "of unbulkied water released from the Olympus Dam would increase as indicated" as it traveled down the canyon. (alteration added). Moreover, according to plaintiffs, Mr. Brown explained that "the Bureau's release of storage flows overnight raised the volume, velocity, and erosion potential of the Big Thompson as it flowed past plaintiffs' properties overnight and through the morning of Sep. 13 when the Orr home and Carman business were destroyed."⁵¹ Plaintiffs argue that Mr. Brown based his model "on the Colorado Department of Transportation's independent study results for stream basins," which, according to plaintiffs, "is considered an authoritative analysis of the 2013 flood event by the hydrology community."⁵²

Plaintiffs contend that defendant's two expert witnesses, Dr. McMahon and Dr. Bowles,⁵³ were not credible. Plaintiffs argue that Dr. McMahon's testimony at trial agreed with plaintiffs' characterization of bulking of water released from Olympus Dam, and plaintiffs argue, quoting Dr. McMahon, that "water passing through the spill gates, from the top of the pool, would be 'relatively pure water without the rocks, debris, sediment in it' and would 'tend to bulk up again'" after being released from Olympus Dam. Plaintiffs argue that "Dr. McMahon steadfastly refused to acknowledge that sediment-laden, bulked

⁵¹ Ms. Orr testified at trial that her home was partially destroyed by the September 2013 flood.

⁵² As explained above, Mr. Brown's expert report relied on data from the Phase One Memorandum that was included in the Colorado Department of Transportation 2014 Hydrology Report. The Phase One Memorandum data was developed by Bob Jarrett of Applied Weather Associates, whereas the Colorado Department of Transportation 2014 Hydrology Report was prepared by the Jacobs Engineering Group.

⁵³ The credibility of defendant's expert Dr. Bowles is also discussed below with respect to the application of the necessity doctrine.

inflowing water had a higher proportion of sediment to water than relatively pure, unbulked water released from Lake Estes.” Moreover, plaintiffs argue that Dr. McMahon “did not consider the fact that 97% of the water impounded in Lake Estes is ‘project water,’” stored for use by the C-BT, nor “that Lake Estes was nearly full when the storm came and that overnight on September 12-13 and through the morning when the storm was at its peak the Bureau chose to draw Lake Estes down and thus release stored ‘project water.’” Plaintiffs further argue that Dr. McMahon was unfamiliar with plaintiffs’ properties or their riverbanks before the September 2013 storm, and that Dr. McMahon’s model relied on geometric data that reflected the properties’ condition in 2015, after the September 2013 storm, rather than before the September 2013 storm. In addition, plaintiffs further argue that Dr. McMahon’s model was based on insufficiently specific rainfall data which did not account for different runoff amounts at different locations in the Big Thompson River Canyon. Furthermore, plaintiffs argue, based on Mr. Brown’s response to Dr. McMahon’s model, that Dr. McMahon’s model could not be verified by reference to the Colorado Department of Transportation’s data, and that “measurements like high water marks” were not used to calibrate Dr. McMahon’s model. Plaintiffs also argue that Dr. McMahon’s model indicated that water took three hours to reach plaintiffs’ properties after being released from Olympus Dam, while plaintiffs claim that released water “actually took half that time” to travel that distance, because plaintiffs describe the Bureau of Reclamation’s Post Incident Analysis Report as stating “it took four hours for a wave of 2700cfs released from the Olympus Dam to reach the mouth of the canyon.” Moreover, plaintiffs argue that Dr. McMahon did not account for the absence of Lake Estes in Dr. McMahon’s model of a scenario without Olympus Dam, which plaintiffs argue “may” account for Dr. McMahon’s conclusion that flooding would have been worse absent Olympus Dam.

With respect to Dr. Bowles, as explained further below, plaintiffs argue that Dr. Bowles’ assessment of the danger posed to Olympus Dam by the September 2013 storm is inconsistent with the testimony of Mr. Bailey and Ms. O’Brien, who plaintiffs argue “both testified that the Olympus Dam was never in danger of failing or breaching.” Plaintiffs state that because Dr. Bowles only analyzed hypothetical scenarios of fixed releases from Olympus Dam, “Dr. Bowles offered no opinions about what actually occurred in the 2013 storm.” Plaintiffs further argue that “Dr. Bowles’ calculations were biased by selecting an arbitrarily high level of water to start his calculations as opposed to the much lower levels actually present at 0815 that morning” on September 12, 2013. Moreover, according to plaintiffs, “Dr. Bowles had no opinion on how long the dam could safely withstand a gate being overtopped with a lake elevation over 7475 feet.”

Defendant challenges plaintiffs’ characterization of the expert witnesses’ findings. Defendant not only argues that “it [defendant] did not cause the flooding and erosion of Plaintiffs’ properties,” but also that plaintiffs’ expert Mr. Brown’s conclusions “on this issue do not establish causation as a matter of law.” (alteration added). Defendant asserts that Mr. Brown “conducted no analysis of what would have happened absent the dam,” and “did not conduct any hydrologic modeling,” but instead only “took the peak flow results that he believed the Colorado Department of Transportation calculated for the September 2013 storm at the confluence of the North Fork Big Thompson and Big Thompson Rivers and Drake,” and Mr. Brown “subtracted a single Olympus Dam release from that number (with adjustments for potential debris in the flow).” Defendant contends that Mr. Brown

did not account for the Olympus Tunnel, which the Bureau used “to take water off the Big Thompson River” during the September 2013 storm, and which “additional water would have contributed to the flow at Plaintiffs’ properties in the absent-the-dam world.”

Moreover, defendant argues that Mr. Brown “did not calculate and does not know when peak flow occurred at the confluence or at Plaintiffs’ properties,” because the Colorado Department of Transportation 2014 Hydrology Report on which Mr. Brown based his calculations “did not determine the time of any peak flows.” According to defendant, Mr. Brown “cannot credibly opine that there would have been no flooding or erosion if not for the storage flow,” because “he admitted at trial that erosion *would have occurred* at the properties absent the storage release he identified,” (emphasis in original), but “Mr. Brown did not and could not quantify the difference in erosion between his ‘theoretical peak flow’ and the peak flow he believed occurred during the storm.” Defendant points out that Mr. Brown’s “lowest ‘theoretical peak flow’” was 13,356 cfs, which, according to the Emergency Action Plan for Olympus Dam, was over the 1,500 cfs of water needed to “begin to flood permanent residences” and over the 6,000 cfs of water needed to “inundate most structures in the canyon.” Defendant argues that absent Olympus Dam, “even more water would have been in the river at the time of peak inflow to Lake Estes.”

Moreover, defendant also argues that plaintiffs’ expert Mr. Brown’s modeling was based on a misunderstanding of the Colorado Department of Transportation data relating to the September 2013 storm. According to defendant, Mr. Brown’s calculations are based on peak flow estimates from the Phase One Memorandum included in the Colorado Department of Transportation 2014 Hydrology Report, rather than from the report itself, and “the July 2014 memorandum was a preliminary report of peak flow estimates based on field observations of high water marks” rather than the result of modeling. Defendant argues that because Mr. Brown relied on the Phase One Memorandum peak flow estimates, rather than on the Colorado Department of Transportation 2014 Hydrology Report’s calculated peak flows, the court should “reject his work and opinions.”

Defendant additionally argues that “[w]ater was already flooding the Carmans’ yard by 10 a.m. on September 12,” when flow in the Big Thompson River “was only 11,000 cfs” according to the analysis of defendant’s expert Dr. McMahon, and the river was “starting to rise out of its banks and onto” Ms. Orr’s property “by the morning of September 12,” which, according to defendant, indicates that plaintiffs’ properties were flooding hours before the 722 cfs storage flow release from Olympus Dam identified by Mr. Brown. (alteration added). Defendant emphasizes the extent of the flooding at plaintiffs’ properties immediately prior to plaintiffs’ leaving their homes, resulting in “*three to four feet* of water” in the Carmans’ basement at approximately 6:00 p.m. on September 12, 2013, and ripping Ms. Orr’s “picnic table out of its concrete moorings” at approximately 11:30 p.m. on September 12, all of which occurred before the storage flow releases identified by Mr. Brown and while the total flow in the river was below Mr. Brown’s calculated theoretical peak flow. (emphasis in original).

Defendant also relies on its expert witness, Dr. McMahon, to argue “that Plaintiffs would have suffered flooding and erosion absent Olympus Dam,” and that “Plaintiffs would have been worse off absent Olympus Dam.” According to defendant, quoting from Dr. McMahon’s expert report, Dr. McMahon’s “unimpaired scenario ‘represents the without-[C-BT] project condition, in which flow at the site of Olympus Dam is the flow that would have naturally occurred during the 2013 flood had the dam and [Lake Estes] reservoir, Adams Tunnel, and Olympus Tunnel never been built.’” (alterations added). Defendant argues that Dr. McMahon’s model is more credible than Mr. Brown’s, in part because Dr. McMahon’s calculated flows for the storm as it actually happened were “within approximately 0.9%” of the calculated flows in the Colorado Department of Transportation 2014 Hydrology Report. Defendant further emphasizes that the September 2013 storm “was a storm of historic proportions,” and that “extreme amounts of water would have flowed downstream through Big Thompson Canyon regardless of Olympus Dam.” Moreover, because Dr. McMahon calculated the North Fork Big Thompson River to have had over 7,000 cfs in peak flow, and the North Fork Big Thompson River’s flow was not affected by the Bureau’s operation of Olympus Dam, defendant argues that “Plaintiffs would have suffered severe flooding and erosion absent Olympus dam.”

The United States Court of Appeals for the Federal Circuit addressed the causation requirement of Arkansas Game & Fish Commission in its decision in St. Bernard Parish Government v. United States, 887 F.3d 1354, which, similar to the above captioned case, was a flooding case. The Federal Circuit in St. Bernard Parish explained that “[c]ausation requires a showing of ‘what would have occurred’ if the government had not acted,” and that “a plaintiff must show that in the ordinary course of events, absent government action, plaintiffs would not have suffered the injury.” Id. at 1362 (alteration added) (quoting United States v. Archer, 241 U.S. 119, 132 (1916)). The Federal Circuit further explained:

Thus, for example, in Archer, plaintiffs claimed that the government’s construction of a dike on their property constituted a taking because the construction of the dike caused depositing of sand and gravel on their land. 241 U.S. at 128, 36 S. Ct. 521. Due to the possibility that without the dike, a river may have flowed through plaintiff’s property and permanently submerged the property, the Supreme Court remanded the case to determine whether the testimony demonstrated “what would have occurred if the dike had not been constructed.” Id. at 132, 36 S. Ct. 521. In Sanguinetti v. United States, plaintiffs brought a takings claim alleging that a canal built by the government caused flooding damage. 264 U.S. [146,] 147, 44 S. Ct. 264 [(1924)]. The Court noted the relevance of whether “[t]he land would have been flooded if the canal had not been constructed.” Id.; see Danforth v. United States, 308 U.S. 271, 286, 60 S. Ct. 231, 84 L. Ed. 240 (1939) (“The Government could become liable for a taking . . . by such construction as would put upon this land a burden, actually experienced, of caring for floods greater than it bore prior to the construction.”); see also Arkansas Game, 568 U.S. at 34, 133 S. Ct. 511.

Our cases are to the same effect. In Accardi v. United States, the government built a dam, and after a severe storm with unexpected precipitation, water flowed onto plaintiffs' property. 599 F.2d 423 (Ct. Cl. 1979). The court explained that "plaintiffs have wholly failed to show that defendant's construction or operation of the [dam] subjected their lands to any additional flooding above what would have occurred in consequence of the severe . . . storm had defendant not constructed the [dam] at all." Id. at 429–30. The court then held that "[i]n these circumstances, there has been no taking of plaintiffs' property." Id. at 430. Thus, the causation analysis requires the plaintiff to establish what damage would have occurred without government action.

St. Bernard Par. Gov't v. United States, 887 F.3d at 1362-63 (emphasis in original; first three alterations added; footnote omitted). In the St. Bernard Parish case, the Federal Circuit held the plaintiffs "failed to present evidence comparing the flood damage that actually occurred to the flood damage that would have occurred if there had been no government action at all," in particular "fail[ing] to take account of other government actions" such as "the construction of a vast system of levees to protect against hurricane damage" which the Federal Circuit held "mitigated the impact of MRGO [Mississippi River Gulf Outlet] and may well have placed the plaintiffs in a better position than if the government had taken no action at all." Id. at 1363 (alterations added; footnote omitted).

Moreover, in St. Bernard Parish, the Federal Circuit rejected plaintiffs' argument for causation on the basis only of the Mississippi River Gulf Outlet construction and operation, without considering the impact of the construction of another federal government structure, the Lake Pontchartrain and Vicinity Hurricane Protection Project. See id. The Federal Circuit explained that plaintiffs had considered "isolated government actions," which was "inconsistent with governing Supreme Court and Federal Circuit authority," concluding: "These cases establish that the causation analysis must consider the impact of the entirety of government actions that address the relevant risk." Id. at 1364.

In St. Bernard Parish, the Federal Circuit referred to a United States Supreme Court case, United States v. Sponenbarger, 308 U.S. 256 (1939). In United States v. Sponenbarger, the Supreme Court rejected the claim of an owner of flood-prone land within a government flood control plan, see id. at 263-64, in part, because "[t]he Government has not subjected respondent's land to any additional flooding, above what would occur if the Government had not acted." See id. at 266 (alteration added). The Supreme Court in Sponenbarger further held that there were "far reaching benefits which respondent's land enjoys from the Government's entire program" and that "if governmental activities inflict slight damage upon land in one respect and actually confer great benefits when measured in the whole, to compensate the landowner further would be to grant him a special bounty." Id. at 266-67.

In St. Bernard Parish Government v. United States, 887 F.3d at 1364-65, the United States Court of Appeals for the Federal Circuit also referred to the Federal Circuit's decision in Arkansas Game & Fish Commission on remand from the Supreme Court. See

Arkansas Game & Fish Comm'n v. United States, 736 F.3d 1364 (Fed. Cir. 2013). Applying the causation analysis of the Supreme Court's Arkansas Game & Fish Commission framework, the Federal Circuit found persuasive testimony by experts that "deviations," or water releases contrary to policy, had "caused the flooding," which in turn caused the damage in that case. See Arkansas Game & Fish Comm'n v. United States, 736 F.3d at 1371. The Federal Circuit explained in Arkansas Game & Fish Commission on remand, "the proper comparison would be between the flooding that occurred prior to the construction of Clearwater Dam and the flooding that occurred during the deviation period," rather than limiting the analysis to the period in which the policy had been in place. See id. at 1372 n.2. According to the Federal Circuit in St. Bernard Parish, the explanation in the Arkansas Game & Fish Commission opinion on remand "emphasiz[ed]" that the causation analysis considers causation based on the entirety of government action, not merely the deviation from the original water-release policy." See St. Bernard Par. Gov't v. United States, 887 F.3d at 1365 (alteration added).

In addition, in St. Bernard Parish, the Federal Circuit also cited John B. Hardwicke Co. v. United States, 199 Ct. Cl. 388, 467 F.2d 488 (1972), which concerned flooding of claimants' land by water diverted by the closing of a dam on the Rio Grande. See id. at 390. In Hardwicke, the United States Court of Claims found that two dams had been constructed on the river which impacted flooding on the claimants' land, Falcon Dam, the operation of which "reduced the anticipated incidence of flooding on the land at issue from once every two years to once every ten years," and Anzalduas Dam, the operation of which "increased the incidence of flooding on the land in question to once every seven or eight years." See id. at 391-92. The Court of Claims observed that with both dams, "the expectation of flooding was still far less than it would have been if there had been no flood control program at all," id. at 392, and held that "plaintiffs cannot base a taking claim on the hypothesis that they can garner the benefit conferred by Falcon, without deduction for the probable detriment when Anzalduas comes into being too." Id. at 394.

The Federal Circuit in St. Bernard Parish also explained with respect to consideration of the entirety of the government actions "in determining causation," that "[w]hen the government takes actions that are directly related to the preventing the same type of injury on the same property where the damage occurred, such action must be taken into account even if the two actions were not the result of the same project." St. Bernard Par. Gov't v. United States, 887 F.3d at 1366 (alteration added). Moreover, "[w]hen government action mitigates the type of adverse impact that is alleged to be a taking, it must be considered in the causation analysis, regardless of whether it was formally related to the government project that contributed to the harm." Id. at 1367 (alteration added).

The United States Court of Claims' decision in Accardi v. United States, 220 Ct. Cl. 347, 599 F.2d 423, is also relevant to the causation analysis in the above captioned case. The plaintiffs in Accardi owned property downstream of Trinity Dam on the Trinity River in California, see id. at 349-50, and alleged that the Bureau of Reclamation's operation of Trinity Dam resulted in takings of their properties in the form of flooding during a 1974 storm. See id. at 355-56. The Court of Claims rejected the Accardi plaintiffs' arguments, explaining that "[h]ad Trinity Dam not been in operation in January 1974,

plaintiffs' real properties in the Poker Bar area would have experienced the full force of a peak inflow of 107,700 c.f.s., and of a mean daily inflow of 72,550 c.f.s. of water," whereas Trinity Dam's operation involved releases "of no more than 14,800 c.f.s. of water, with releases at that level persisting for less than 30 minutes." See id. at 357 (alteration added). The Court of Claims decision found "that the flooding which actually occurred in consequence of that storm was far less than would have been the case had the Trinity River division never been built," and, therefore, held that the United States had not taken the plaintiffs' properties. Id. at 358.

Precedents of the United States Supreme Court, the United States Court of Appeals for the Federal Circuit, and the United States Court of Claims discussed above demonstrate that plaintiffs must prove that absent the government's actions, namely the construction and operation of Olympus Dam and the other C-BT facilities, including the releases of water from Olympus Dam into the Big Thompson River, the damage to plaintiffs' properties would not have occurred. The parties have focused on separate aspects of the causation inquiry in their arguments in post-trial briefing. Plaintiffs' arguments concentrated on the releases from the Olympus Dam during the course of the September 2013 storm, and, therefore, plaintiffs have focused on the operation of the Olympus Dam by the Bureau of Reclamation, including the peak water releases of September 12 and 13, 2013. Defendant, by contrast, focused its argument on the existence of the Olympus Dam and other C-BT structures, concentrating on the hypothetical world "absent the dam," and comparing the September 2013 storm as it happened to the September 2013 storm as it would have transpired if Olympus Dam, and other C-BT structures, did not exist. In contrast to both parties' approaches, however, the Federal Circuit explained in St. Bernard Parish that plaintiffs' burden is to prove causation in light of "the entirety of government actions that address the relevant risk." See St. Bernard Par. Gov't v. United States, 887 F.3d at 1364. Because both the existence of the Olympus Dam generally, and the operation of Olympus Dam during the September 2013 storm, including specifically the releases from Olympus Dam into the Big Thompson River, "address the relevant risk," id., by affecting the flow of water in the Big Thompson River, both the existence of the Olympus Dam and the operation, including the water releases, of the Olympus Dam, must be considered in the causation analysis in the above captioned case.

Multiple witnesses from the Bureau of Reclamation testified that Olympus Dam is "not a flood control dam," but is rather a small and "reactive" reservoir, which can neither store nor release large quantities of water. The data in the Colorado Department of Transportation 2014 Hydrology Report supports this assessment of the Olympus Dam. The Colorado Department of Transportation 2014 Hydrology Report calculated that the Big Thompson River above the Drake confluence had a peak flow between 7,534 cfs and 7,566 cfs, while the North Fork Big Thompson River at the Drake confluence had a peak flow between 7,706 cfs and 7,723 cfs. Therefore, even when the Big Thompson River above Drake was at its maximum flow rate during the September 2013 storm, the Big Thompson River still had less flow rate than the maximum flow rate of the North Fork Big Thompson River. This discrepancy between the Big Thompson River and the North Fork Big Thompson River prior to the two joining at the Drake confluence indicates that, even at its most intense flow, the Big Thompson River above Drake contributed less to the

combined flow at the plaintiffs' properties than did the North Fork Big Thompson River. Moreover, only the Big Thompson River's flow was impacted by releases from Olympus Dam, and the water released from Olympus Dam also mixed with rainfall and other runoff in the thirteen miles between Olympus Dam and the Drake confluence. Therefore, although the amounts released may have been significant for Olympus Dam, they were less significant in the context of the total amount of water flowing through both rivers and joining at the confluence at Drake.

The model created by Dr. McMahon, defendant's expert, indicates that the presence of Olympus Dam resulted in a measurable decrease in peak flow rate, to 15,011 cfs at plaintiffs' properties, compared to the "unimpaired flow" model, with a peak flow of 15,108 cfs at plaintiffs' properties. When considering the totality of all government actions taken during the September 2013 storm, the flow of water could have been far greater absent the dam. As the testimonies of several of the Bureau of Reclamation employees indicate, the water schedulers continuously monitored the water elevation in Lake Estes and increased their outflows through Olympus Dam gradually to account for rising water elevation. They testified that this constant monitoring and adjustment of spillway releases was carefully considered and administered to keep the Olympus Dam intact. As defendant's expert, Dr. Bowles' model suggests, if the government officials had not engaged in their gradual increases of releases of water downstream, or even had left releases constant, it could have produced, at minimum, days of water overtopping certain portions of Olympus Dam.⁵⁴ As Dr. Bowles, as well as a number of the Bureau of Reclamation employees, testified, overtopping of even the lowest portions of Olympus Dam, the closed spillway gates, could have resulted in dam failure and uncontrolled releases downstream, which would have exceeded the peak flows experienced by plaintiffs' properties.

Contrary to plaintiffs' arguments, the expert report prepared by plaintiffs' expert Mr. Brown supports this assessment. As discussed above, Mr. Brown calculated a release of 722 cfs of stored water from Lake Estes through Olympus Dam at the time of peak release at 11:45 p.m. on September 12, 2013. Mr. Brown further applied three bulking factors to his calculated storage release, and the largest bulking factor, 2.0, would increase the volume of the storage flow to 1,444 cfs. The Colorado Department of Transportation's 2014 Hydrology Report, however, calculated the peak flow of the Big Thompson River below the confluence at Drake to be between 14,728 cfs and 14,731 cfs. Even assuming that the largest bulking factor calculated by Mr. Brown was accurate, there would still have been at least 13,284 cfs in the peak flow at plaintiffs' properties downstream of the Drake confluence if no storage flows, as identified by Mr. Brown, had been released.

Further, according to the trial testimony of Ms. Orr, Mr. Carman, and Mrs. Carman, water in the Big Thompson River adjacent to plaintiffs' properties rose throughout the day of September 12, 2013, at first in the banks of the Big Thompson River and then onto the

⁵⁴ As discussed above, Dr. Bowles calculated that if Olympus Dam had been limited, for example, to a single gate opening with an opening of 2.50 feet, "the maximum opening for remote operation," that would have resulted in an overtopping of the closed spillway gates "for almost five days."

surrounding property. Water entered the lower yard of the Carmans' property, which was close to the Big Thompson River, and then the basement of the Carmans' house, between the late morning and the early afternoon of September 12. Around 6:00 p.m. on September 12, shortly before the Carmans left their property to spend the night at their neighbor's house, the water was three to four feet deep in the Carmans' basement. By approximately 11:30 p.m., shortly before Ms. Orr left her property for her neighbor's house, Ms. Orr saw the still rising water of the river rip her picnic table out of the concrete in which it was set. These events, documenting the encroachment of the floodwaters onto plaintiffs' properties, all occurred prior to the peak release from Olympus Dam. Moreover, even assuming that the peak release from Olympus Dam coincided with the peak flow in the Big Thompson River near plaintiffs' properties, the peak release's contribution to the peak flow at plaintiffs' properties would amount to less than ten percent of the peak flow at either the Orr or Carman properties.

Based on the evidence in the record before the court and the testimony of the plaintiffs, the flooding of plaintiffs' properties began hours before the peak releases were made from Olympus Dam in response to the September 2013 storm, and further hours before those releases arrived at plaintiffs' properties. Moreover, when the peak releases from Olympus Dam did arrive, the contribution of the peak releases, even with the maximum bulking factor proposed by plaintiff's expert Mr. Brown, appear to have contributed no more than 1,444 cfs out of the 14,728 cfs to 14,731 cfs peak flow which was present in the Big Thompson River near plaintiffs' properties. Additionally, as the data contained in the Colorado Department of Transportation 2014 Hydrology Report demonstrates, more than half of the water in the Big Thompson River near plaintiffs' properties came from the North Fork Big Thompson River above the confluence at Drake, rather than coming directly from the Big Thompson River above Drake into which Olympus Dam releases water. Based on the testimony at trial, specifically the testimony addressing the Bureau employees' actions during the September 2013 storm, and the exhibits in the record, the court finds that plaintiffs have failed to establish that the Bureau of Reclamation's operation of Olympus Dam during the September 2013 storm, in particular the Bureau's peak releases during the storm on September 12 and 13, 2013, caused the damage at plaintiffs' properties. Because plaintiffs have failed to carry their burden to establish that the Bureau of Reclamation's actions, including the existence of the Olympus Dam and defendant's operation of the Olympus Dam, including the water releases, during the September 2013 storm, caused the flooding of plaintiffs' properties, plaintiffs cannot succeed on their takings claims under the Arkansas Game & Fish Commission analysis. See St. Bernard Par. Gov't v. United States, 887 F.3d at 1364; Arkansas Game & Fish Comm'n v. United States, 736 F.3d at 1371. Although plaintiffs have not demonstrated causation, the court briefly addresses below, for the benefit of the parties' understanding, the remaining Arkansas Game & Fish Commission factors: time and duration, intent or foreseeability, reasonableness of investment-backed expectations, and severity. The court reiterates, however, that because plaintiffs have not demonstrated causation, plaintiffs have not met their burden to prove a taking of their properties.

Time and Duration

To continue with a discussion of the Arkansas Game & Fish Commission factors, plaintiffs argue with respect to time and duration that “the floodwaters re-routed the river and permanently deprived the plaintiffs of their property by eroding the banks of their properties,” and that “the floodwaters temporarily inundated other parts of the Orr and Carman properties.” According to plaintiffs, “repetition is not necessary when intent or foreseeability is established.” (citing Eyherabide v. United States, 170 Ct. Cl. 598, 604-05, 345 F.2d 565, 569 (1965)). Plaintiffs argue that requiring repetition in order to prove a taking would amount to allowing the government “one-free-flood” before being subject to liability. Defendant responds that “the Bureau did not preempt Plaintiffs’ rights to enjoy their properties for an extended period,” but rather “[t]his was a one-time, limited duration flood event.” (alteration added).

The Supreme Court in United States v. Cress stated that “[t]here is no difference of kind, but only of degree, between a permanent condition of continual overflow by backwater and a permanent liability to intermittent but inevitably recurring overflows; and, on principle, the right to compensation must arise in the one case as in the other.” United States v. Cress, 243 U.S. at 328 (alteration added). Moreover, as a Judge of the Court of Federal Claims in In re Upstream Addicks and Barker (Texas) Flood-Control Reservoirs, 146 Fed. Cl. 219, held, when “the government’s actions have subjected plaintiffs’ private properties to the possibility, rather probability, of government induced flooding,” the length of the taking “is measured by a permanent right to inundate the property with impounded flood waters.” *Id.* at 250; see also Quebedeaux v. United States, 112 Fed. Cl. 317, 323 (2013) (“[I]t is conceivable that a takings might lie where defendant, using a permanent structure, purposely floods a property once and expressly reserves the right to do so in the future.” (alteration added)).

As indicated above, the United States Supreme Court in Cedar Point Nursery v. Hassid also addressed the durational difference between a taking and a tort. The Supreme Court in Cedar Point Nursery quoted the Supreme Court’s earlier decision in Portsmouth Harbor Land & Hotel Co. v. United States, 260 U.S. 327, explaining that “[w]hile a single act may not be enough, a continuance of them in sufficient number and for a sufficient time may prove [the intent to take property]. Every successive trespass adds to the force of the evidence.” Cedar Point Nursery v. Hassid, 141 S. Ct. at 2078 (first alteration added) (quoting Portsmouth Harbor Land & Hotel Co. v. United States, 260 U.S. at 329-30). The Portsmouth Harbor case concerned a resort property which adjoined property of the United States government, “upon which the Government has erected a fort, the guns of which have a range over the whole sea front of the claimants’ property.” See Portsmouth Harbor Land & Hotel Co. v. United States, 260 U.S. at 328. The Supreme Court in Portsmouth Harbor explained that in prior cases concerning the same property,

the mere erection of the fort and the fact that guns were fired over the claimants’ land upon two occasions about two years and a half before the suit was brought, coupled with the apprehension that the firing would be repeated, but with no proof of intent to repeat it other than the facts stated,

did not require the finding of an appropriation and a promise to pay by the United States,

nor did “some occasional subsequent acts of gun fire” effect a taking. Id. at 328 (quoting Portsmouth Harbor Land & Hotel Co. v. United States, 250 U.S. 1, 2 (1919)). The Supreme Court in the Portsmouth Harbor decision considered additional actions the government had taken since the prior cases at the same location, namely that “the United States has set up heavy coast defence [sic] guns with the intention of firing them over the claimants’ land and without the intent or ability to fire them except over that land” and that the government “has established upon that land a fire control station and service, and in December, 1920, it again discharged all of the guns over and across the same land.” See id. at 329 (alteration added). The Supreme Court concluded that “[t]he establishment of a fire control is an indication of an abiding purpose” and therefore that “the specific facts set forth would warrant a finding that a servitude has been imposed.” Id. at 330 (alteration added).

The United States Supreme Court in Cedar Point Nursery also favorably cited the decision of the United States Court of Appeals for the Federal Circuit in Hendler v. United States, 952 F.2d 1364 (Fed. Cir. 1991), in which the Federal Circuit “identif[ied] a ‘truckdriver parking on someone’s vacant land to eat lunch’ as an example of mere trespass.” See Cedar Point Nursery v. Hassid, 141 S. Ct. at 2078 (alteration added) (quoting Hendler v. United States, 952 F.2d at 1377). The Federal Circuit’s decision in Hendler concerned the Environmental Protection Agency’s efforts “to combat ground water pollution from a major hazardous waste site, the Stringfellow Acid Pits in California,” and “the Government decided to locate ground water wells and associated equipment in the general area of the acid pits,” including “nearby properties” owned by the Hendler plaintiffs. See Hendler v. United States, 952 F.2d at 1367. The Federal Circuit in Hendler addressed the durational analysis in takings cases by example:

Occasionally an issue arose as to whether the government's activity was so short lived as to be more like the tort of trespass than a taking of property. The distinction between the government vehicle parked one day on O’s land while the driver eats lunch, on the one hand, and the entry on O’s land by the government for the purpose of establishing a long term storage lot for vehicles and equipment, on the other, is clear enough.

Id. at 1371 (citing J. SACKMAN, NICHOLS’ THE LAW OF EMINENT DOMAIN § 8 (1991)). With respect to the durational analysis, the Federal Circuit has explained, “[a] taking can be for a limited term—what is ‘taken’ is, in the language of real property law, an estate for years, that is, a term of finite duration as distinct from the infinite term of an estate in fee simple absolute.” Id. at 1376 (alteration added). Recalling its example of the driver stopping to eat lunch, the Federal Circuit further explained that the word “temporary” “logically refers to those governmental activities which involve an occupancy that is transient and relatively inconsequential, and thus properly can be viewed as no more than a common

law trespass quare clausum fregit.^[55] Our truckdriver parking on someone's vacant land to eat lunch is an example." Id. at 1377 (footnote added).

Plaintiffs indicate in their trial testimony that they can recall two occasions on which their properties flooded, once in 1976, and again in 2013, in the storm at issue in the above captioned case. Plaintiffs have not testified to, nor does any evidence in the record indicate, that other significant floods have occurred in the Big Thompson River Canyon which have affected plaintiffs' properties. There also is no evidence that the Bureau of Reclamation specifically "reserve[d] the right," either at the time of the September 2013 storm or since, to flood plaintiffs' properties again. See Quebedeaux v. United States, 112 Fed. Cl. at 323 (alteration added). The lack of a reservation of rights to flood the plaintiffs' properties again, as well as the infrequency of flooding, twice in 37 years, indicates that, rather than a probability of future "government induced flooding," In re Upstream Addicks and Barker (Texas) Flood-Control Reservoirs, 146 Fed. Cl. at 250, or "a permanent liability to intermittent but inevitably recurring overflows," the flooding of plaintiffs' properties was an infrequent and unusual event. See United States v. Cress, 243 U.S. at 328. Additionally, the parties jointly stipulated that "[t]he annual exceedance probability of the September 2013 storm event ranged as low as 0.1%. In other words, the September 2013 storms may have been a 1,000-year storm event." (alteration added). Plaintiffs' expert Mr. Brown, similarly, determined that plaintiffs' properties experienced flooding for approximately eighteen-and-a-half hours. Moreover, as plaintiffs testified at trial, the consequential flooding of Ms. Orr's property occurred from the evening of September 12 to the morning of September 13, 2013. The flooding of Mr. and Mrs. Carman's property, which had a large portion of land that was closer to the river and in the flood plain, began in the afternoon of September 12, and by mid-morning of September 13, the water had receded enough to allow the Carmans to re-enter their land. Accordingly, the flooding which damaged plaintiffs' properties, as well as being the first flood to occur since 1976 in the Big Thompson River Canyon, lasted less than a full day. Therefore, the flooding of plaintiffs' properties was "transient and relatively inconsequential" in terms of the duration of the alleged taking. See Hendler v. United States, 952 F.2d at 1377. Accordingly, plaintiffs have not carried their burden to demonstrate the time and duration element of the Arkansas Game & Fish Commission analysis.

Intent or Foreseeability

The United States Supreme Court in Arkansas Game & Fish Commission stated that "[a]lso relevant to the takings inquiry is the degree to which the invasion is intended or is the foreseeable result of authorized government action." Arkansas Game & Fish Commission v. United States, 568 U.S. at 39 (alteration added). Subsequently, a Judge of the Court of Federal Claims explained that, under this inquiry, "[a] taking occurs either where the government intended to invade the property or where the invasion is the 'direct,

⁵⁵ "Quare clausum fregit" is a Latin phrase meaning "[w]hy he broke the close." See Quare Clausum Fregit, BLACK'S LAW DICTIONARY (11th ed. 2019) (alteration added). A "trespass quare clausum fregit" is a tort defined as "[a] person's unlawful entry on another's land that is visibly enclosed." Trespass, BLACK'S LAW DICTIONARY (11th ed. 2019) (alteration added).

natural, or probable result of an authorized activity and not the incidental or consequential inquiry inflicted by the action.” In re Upstream Addicks and Barker (Texas) Flood-Control Reservoirs, 146 Fed. Cl. at 254 (alteration added) (quoting Ridge Line, Inc. v. United States, 346 F.3d at 1355 (internal quotation omitted)). Moreover, “[d]espite being separate inquiries, the two factors are interrelated—one cannot find intent without foreseeability; but what is an objectively foreseeable result may not have been the intended result.” In re Upstream Addicks and Barker (Texas) Flood-Control Reservoirs, 146 Fed. Cl. at 254 (alteration added) (citing John Horstmann Co. v. United States, 257 U.S. 138, 146 (1921); Columbia Basin Orchard v. United States, 132 Ct. Cl. 445, 452, 132 F. Supp. 707, 711 (1955)). The United States Court of Appeals for the Federal Circuit in Moden v. United States, 404 F.3d 1335 (Fed. Cir. 2005), explained that a “plaintiff must prove that the government should have predicted or foreseen the resulting injury.” Id. at 1343. Moreover, the flooding must be “the actual and natural consequence of the government’s act,” but “injury may not be foreseeable if an intervening cause breaks the chain of causation.” Id. at 1344 (quoting Avery v. United States, 165 Ct. Cl. 357, 364-65, 320 F.2d 640, 644-45 (1964) (internal quotations omitted)). Additionally, foreseeability “is not simply measured from the viewpoint of the government; foreseeability is an objective inquiry.” In re Upstream Addicks & Barker (Texas) Flood-Control Reservoirs, 146 Fed. Cl. at 255.

Plaintiffs argue that “the evidence established that the Bureau made a conscious decision on the night of February [sic] 12-13, 2013, to increase releases from Olympus Dam to as much as 6100 cfs,” when the Bureau knew from its Emergency Action Plan “that releases over 1500 cfs can cause flooding below, and releases of 6000 cfs cause most of the properties to be inundated, and there is also the possibility of loss of life.” (alteration added). Plaintiffs further argue that the Bureau increased releases through the Olympus Dam “to preserve a 1-foot buffer between the top of Lake Estes and the top of the spillway gates” and that the Bureau also “made the decision to reduce flows in the Olympus Tunnel from 550 cfs to 200 cfs,” necessitating the increased releases through Olympus Dam, “because the [Pole Hill] power plant was shutting down and it did not want to run the additional flows through the Pine Hill Rediversion Structure.” (alteration added).

Plaintiffs also argue that “the same actions and decisions that benefitted and protected the government’s C-BT properties during the storm,” by not “allowing the elevation of Lake Estes to rise above 7474 feet” are the same “actions that caused takings of the Orr and Carman properties.” According to plaintiffs, “[d]amage to their properties was the direct result of the government’s construction and operation of its C-BT facilities.” (alteration added). Plaintiffs further argue that “[t]he court should determine here “whether the [flooding] on the claimants['] property was the predictable result of the government action.”” (first alteration added) (quoting In re Upstream Addicks & Barker (Texas) Flood-Control Reservoirs, 146 Fed. Cl. at 254 (quoting Ridge Line, Inc. v. United States, 346 F.3d at 1356 (citing Sanguinetti v. United States, 264 U.S. 146, 149-50 (1924)))). According to plaintiffs, the government “knew its releases were likely to inundate and flood downstream properties,” and, therefore, the damages to plaintiffs’ properties were “the natural consequences of the government’s actions.” (quoting In re Upstream Addicks & Barker (Texas) Flood-Control Reservoirs, 146 Fed. Cl. at 255 (internal quotations omitted)). Plaintiffs state that the foreseeability of the damages “is

true whether the court measures foreseeability in terms of only the Bureau's 2013 storm event decisions and actions or over the entire period from when the C-BT and its facilities were conceived of, authorized, and built in the first half of the Twentieth Century."

Defendant argues that because of the historic storm, "[a]ny argument that the flooding of Plaintiffs' properties was the direct, natural, or probable result of the Bureau's releases fails because the historic storm and role of the North Fork Big Thompson River, as discussed above, sever any chain of causation." (alteration added). Defendant also argues that "flooding fourteen to sixteen miles downstream could not benefit the Bureau," and states that it "gained nothing—it appropriated nothing to its benefit—from any alleged additional flooding of Plaintiffs' properties." According to defendant, water from Olympus Dam would be joined by "[r]ainfall and runoff," as well as the confluence of the North Fork Big Thompson River, before it reached plaintiffs' properties, and "[t]his attenuated course of events undermines any 'direct result' argument." (alterations added).

As noted above, the Emergency Action Plan, which governed the operation of the Olympus Dam at the time of the September 2013 storm, provides that "it is at a flow of 1,500 ft³/s in the Big Thompson River that water level first reaches the level of homes and businesses below Olympus Dam," and further that "most structures in the Big Thompson Canyon below Olympus Dam are inundated at a flow of 6,000 ft³/s." This guidance in the Emergency Action Plan indicates that the government was aware during the time of the September 2013 storm of approximately what levels of flow rate in the Big Thompson River would begin to cause certain amounts of flooding. Importantly, the Emergency Action Plan's references to 1,500 cfs and 6,000 cfs refer to flow rate in the Big Thompson River, not to the flow rate of water being discharged from Olympus Dam. As the evidence in the record before the court indicates, the flow in the Big Thompson River near plaintiffs' properties had exceeded the flooding thresholds before the Bureau personnel operating Olympus Dam commenced peak releases at approximately 11:30 p.m. on September 12, 2013. As indicated above, peak flow in the North Fork Big Thompson River above the confluence at Drake exceeded 7,000 cfs, meaning that even with no water in the Big Thompson River above Drake, the addition of the North Fork Big Thompson River alone would have caused the river near plaintiffs' properties to exceed the flow rates at which properties would begin to flood. Moreover, the Bureau personnel studied and appear to have understood the severity of the storm as it was occurring at the relevant time. The Bureau personnel initiated the use of their Incident Management Procedures, including engaging in coordinating efforts with local government through Mr. VanShaar. As of the early morning hours of September 12, 2013, Bureau personnel were onsite at Olympus Dam, in the pouring rain, because the dam had to be operated manually.

The damage to plaintiffs' properties must be "the actual and natural consequence of the government act" in order to support plaintiffs' takings claims. See Moden v. United States, 404 F.3d at 1344 (quoting Avery v. United States, 165 Ct. Cl. at 364-65). When engaging in an "objective inquiry" into the foreseeability of plaintiffs' damages, see In re Upstream Addicks & Barker (Texas) Flood-Control Reservoirs, 146 Fed. Cl. at 255, the higher flow rate in the North Fork Big Thompson River than in the Big Thompson above Drake, which at its peak exceeded 7,000 cfs, along with other potential sources of water such as heavy rainfall and runoff between the Olympus Dam and plaintiffs' properties,

constituted “intervening cause” for plaintiffs’ property damage to “break[] the chain of causation” between the Olympus Dam releases and the damage to plaintiffs’ properties. See Moden v. United States, 404 F.3d at 1344 (alteration added).

As the evidence and testimony introduced at trial demonstrates, the government officials of the Bureau of Reclamation reviewed conditions at the Olympus Dam while they were occurring during the September 11, 12, and 13, 2013 weather events and acted to safely operate Olympus Dam during the September 2013 storm. As multiple government officials testified, Bureau of Reclamation staff were on duty, either remotely or at the dam site, continually from the outset of heavy rain in the late evening of September 11, 2013. Importantly, the water schedulers, Carlos Lora and Tim Miller, had to manage releases through Olympus Dam’s gates with one inoperable gate and no operable gauges upstream of Lake Estes to measure inflow. Also, uncontroverted testimony at trial described Lake Estes as “reactive” because of its shallow reservoir, in which the water elevation could rise or fall quickly. As Dr. Bowles testified, the consequences of overtopping portions of Olympus Dam could have been an uncontrolled release, or even a total failure of the dam. Without functioning upstream gauges or all spillway gates online, which were factors outside the Bureau of Reclamation’s control during the September 2013 storm, the Bureau’s staff, nonetheless, were able to manage releases from Olympus Dam to keep Lake Estes in its operating range. Furthermore, the dam operators did not rapidly open all gates in order to preserve the dam but, as testimony from government officials demonstrates, they gradually increased releases to respond to increasingly heavy rainfall entering the reservoir via runoff beginning September 11 and throughout September 12, 2013. Moreover, the Bureau of Reclamation employees increased releases through Olympus Dam in order to prevent further damage to other structures of the C-BT system, including the damaged Pole Hill Powerplant and Little Hells Canyon Rediversion Structure, for which reason the Bureau had closed Olympus Tunnel and, thereby, the Bureau was left with fewer options to remove water from the Lake Estes reservoir. The conduct of Bureau of Reclamation officials does not evidence an intent to cause flooding downstream of Olympus Dam, but rather to maintain the dam and thereby stop additional flooding. The actions taken by the Bureau of Reclamation personnel during the September 2013 storm, therefore, had the foreseeable and actual effect of preserving Olympus Dam and averting the potentially more catastrophic consequences of dam failure to plaintiffs’ property. For these reasons, plaintiffs have not demonstrated the intent or foreseeability of damage to plaintiffs’ properties from the Bureau’s operation of Olympus Dam.

Reasonable Investment-Backed Expectations

Plaintiffs state that they “assert that this factor was intended to be applied only in regulatory claims,” but nevertheless address the factor as set out in Arkansas Game & Fish Commission v. United States, 568 U.S. at 39.⁵⁶ Plaintiffs argue that “even when a person acquires property with *actual notice* of an *ongoing* taking or that a taking might occur in the future, the claim need not fail.” (emphasis in original) (citing In re Upstream

⁵⁶ As discussed above, plaintiffs’ claims regarding the type of taking at issue in the above captioned case were confused.

Addicks & Barker (Texas) Flood-Control Reservoirs, 146 Fed. Cl. at 261). Plaintiffs further argue that “neither Ms. Orr nor the Carmans knew their properties would flood or be destroyed in a flood after the severe 1976 flood had passed through with a much larger amount of water and not washed away any properties.” Defendant responds, arguing that “Plaintiffs knew their properties could suffer damage from flooding by the Big Thompson River,” because “Plaintiffs knew that the Big Thompson River flowed next to their property [sic],” which “were on the downslope of a narrow canyon,” and because “the 1976 food similarly damaged Plaintiffs’ properties.” (alteration added).

The reasonable investment-backed expectations prong of the Arkansas Game & Fish Commission analysis is distinct from the intent and foreseeability component of that analysis. While intent and foreseeability consider the actions of the government and whether they led to the alleged taking, the reasonable invest-backed expectations analysis considers the character of plaintiffs’ land. In the Arkansas Game & Fish Commission context, courts have considered the susceptibility of the property to flooding prior to the alleged taking. See Arkansas Game & Fish Comm’n v. United States, 568 U.S. at 39 (“For example, the Management Area lies in a floodplain below a dam, and had experienced flooding in the past.”); In re Upstream Addicks & Barker (Texas) Flood-Control Reservoirs, 146 Fed. Cl. at 261 (“In this case, properties are located in a geographical area that is generally susceptible to large storms and potential flooding.”).

Plaintiffs’ testimony and the evidence in the record before the court indicate that when the September 2013 flood occurred, the last flood to damage plaintiffs’ properties had occurred in 1976. As stipulated by the parties and testified to at trial, the plaintiffs held fee simple ownership of their properties beginning in 1976. As a result, for approximately the entire time that plaintiffs owned their property up to the time of the September 2013 storm, about 37 years, the plaintiffs had enjoyed their property with only one serious flood. Moreover, the witnesses at trial testified that the Big Thompson River is ordinarily a small, quiet river with a low flow rate, typically between 50 and 75 cfs, and shallow enough in most places that, as Mr. VanShaar testified, “you could walk across it.” As Mr. and Mrs. Carman testified, however, they were aware at the time they purchased their property, following the 1976 flood, that the property “may be located and situate in a flood plain,” and the Carmans did not construct any permanent structures on the portion of their property closest to the Big Thompson River. Although plaintiffs might reasonably not have been acutely concerned about a flooding on their property, given the riverside location of their property, the upstream dam and the always unpredictable weather, plaintiffs’ expectations that their property would be flood-free in the future could not have been totally secure. Regardless, given the above discussion on causation and intent or foreseeability, success on this factor alone, even if established by plaintiffs, would not establish a taking for the Carman and Orr properties.

Severity

Plaintiffs argue that “**even a single flooding event may give rise to a taking** where the defendant uses a permanent structure to “purposely flood[] a property once and expressly reserves the right to do so in the future.”” (emphasis and alteration in original) (quoting In re Upstream Addicks & Barker (Texas) Flood-Control Reservoirs, 146

Fed. Cl. at 250 (quoting Quebedeaux v. United States, 112 Fed. Cl. at 323)). According to plaintiffs, the “flooding caused devaluation of their properties, destruction of their real and personal property, and displacement from their homes and businesses for an extended period,”⁵⁷ as the September 2013 flood destroyed the Carmans’ home and business and part of Ms. Orr’s home and property, “along with the personal property in the Orr and Carman homes.” The September 2013 flood, according to plaintiffs, led to “the State of Colorado’s determination that in rebuilding after the flood it required their [the Carmans’] property to re-route the highway,” and “involved 0.63 acres of Ms. Orr’s land that has been permanently washed away.” (alteration added).

Defendant argues, however, against the severity factor of plaintiffs’ taking allegations, claiming that plaintiffs “remained free to use, access, or enjoy ownership of their properties,” as demonstrated by the fact that “the Carmans sold their properties to the Colorado Department of Transportation after the storm,” and Ms. Orr’s “land has been reclaimed and filled in, and is no longer under water.” (citing Cary v. United States, 552 F.3d 1373, 1380 (Fed. Cir. 2009)).

The Supreme Court of the United States in Pumpelly v. Green Bay & Mississippi Canal Co., 80 U.S. (13 Wall.) 166, explained “that where real estate is actually invaded by superinduced additions of water, earth, sand, or other material, or by having any artificial structure placed on it, so as to effectually destroy or impair its usefulness, it is a taking” under the Fifth Amendment to the United States Constitution. See id. at 181; see also Ark. Game & Fish Comm’n v. United States, 568 U.S. at 32 (citing Pumpelly v. Green Bay & Miss. Canal Co., 80 U.S. (13 Wall.) at 177); Sanguinetti v. United States, 264 U.S. at 148 (quoting Pumpelly v. Green Bay & Miss. Canal Co., 80 U.S. (13 Wall.) at 181); Vaizburd v. United States, 384 F.3d 1278, 1282 (Fed. Cir. 2004) (“Government action that causes sand accretion, flooding, or accumulation of other materials on a landowner’s property may constitute a physical taking.” (citing Pumpelly v. Green Bay & Miss. Canal Co., 80 U.S. (13 Wall.) at 181)).

A Judge of the United States Court of Federal Claims in Ideker Farms, Inc. v. United States, 151 Fed. Cl. 560 (2020), appeal filed, Nos. 21-1849, 21-1875 (Fed. Cir. Apr. 22, 2021), explained that to analyze the severity of an alleged taking, “the court must determine whether or not ‘the asserted intrusion was within a range that the property owner could have reasonably expected to experience in the natural course of things.’” Id. at 584 (quoting Ark. Game & Fish Comm’n v. United States, 736 F.3d at 1375). Moreover, in the In re Upstream Addicks & Barker (Texas) Flood-Control Reservoirs case, another Judge of the Court of Federal Claims held that “intermittent inundation of land, as contrasted to continuous overflow, can give rise to a viable permanent taking claim,” In re Upstream Addicks & Barker (Texas) Flood-Control Reservoirs, 146 Fed. Cl. at 250 (citing United States v. Cress, 243 U.S. at 328), and that “the fact that property has been or could be, with sufficient outlays, restored to its pre-flood condition is not a relevant

⁵⁷ The court has not accepted any general indication by plaintiffs that Ms. Orr and Mr. and Mrs. Carman lost all of their real and personal property at their respected parcels of land during the September 2013 storm, such as by plaintiffs’ allegation of the “destruction of their real and personal property,” without qualification.

consideration in the severity analysis.” Id. at 252-53 (citing Ark. Game & Fish Comm’n v. United States, 568 U.S. at 26-34; United States v. Dickinson, 331 U.S. 745, 751 (1947)).

Plaintiffs in the above captioned case testified at trial that they lost their homes and personal property as a result of the flooding that occurred during the September 2013 storm. The Carmans additionally testified that they lost their business and their horses because of the damage done to their property by the flooding. As defendant points out, Ms. Orr appears to have reclaimed her property from the riverbed, as plaintiffs’ expert Mr. Potter’s post-flood graphic, based on a Google Earth image from 2019, appears to show land on Ms. Orr’s property, which had been flooded, filled in. As defendant also points out, the Carmans sold their land to the Colorado Department of Transportation for the relocation of Highway 34. The court notes, however, that demonstrating “accretion, flooding, or accumulation of other materials” can be sufficiently severe to support a taking, see Vaizburd v. United States, 384 F.3d at 1282, as is having property “actually invaded by superinduced additions of water, earth, sand, or other material,” Pumpelly v. Green Bay & Mississippi Canal Co., 80 U.S. (13 Wall.) at 181. Similarly, selling or attempting to improve the property in the wake of a flood or other destruction of one’s property does not necessarily diminish the severity of the damage experienced. See In re Upstream Addicks & Barker (Texas) Flood-Control Reservoirs, 146 Fed. Cl. at 252-53 (“[T]he fact that property has been or could be, with sufficient outlays, restored to its pre-flood condition is not a relevant consideration in the severity analysis.” (alteration added)).

The above analysis demonstrates that, by an application of the framework set forth in the United States Supreme Court’s Arkansas Game & Fish Commission decision, plaintiffs in the above captioned case perhaps might have been able to demonstrate that, because plaintiffs lost property in the September 2013 storm, the alleged harm due to the flooding was severe. At trial, however, although plaintiffs each described their losses, no independent evidence on valuation was offered. Moreover, as discussed above, plaintiffs have failed to carry their burden with respect to establishing that the Bureau of Reclamation’s actions caused the loss of plaintiffs’ properties, that the flooding of plaintiffs’ properties was an intentional or the foreseeable result of the government’s actions, or that the flooding attributable to the government was of sufficient duration to constitute a taking.

Necessity Doctrine

Defendant also argues that the United States “is not liable for destruction of real and personal property when, in the case of actual necessity, the government acts to prevent grave threats to life and property.” (citing TrinCo Inv. Co. v. United States, 722 F.3d 1375, 1377 (Fed. Cir. 2013)). Defendant cites the analysis of defendant’s expert Dr. David Bowles, which, as explained above, “assessed three hypothetical cases” of limiting releases from Olympus Dam starting at 2:15 a.m. on September 12, 2013, and continuing for the duration of the September 2013 storm, which differed from the actions taken by the Bureau during the September 2013 storm. Dr. Bowles explained the potential consequences of overtopping the spillway gates of Olympus Dam in his expert report and at trial, testifying regarding potentially jamming the “lifting arms” of the gates and the gates “peel[ing] away” from the dam; exceeding the sliding stability threshold, which would

“propagate[] a crack underneath the dam” because of which “you’d no longer have the dam secured to the ground;” overtopping the left abutment of Olympus Dam, which could “erode out the toe of the dam” and “potentially eat through the dam;” and overtopping the parapet wall of Olympus Dam, which has “the potential to initiate an erosional failure” at the right end of Olympus Dam. (alterations added). Defendant asserts that “in each hypothetical, Olympus Dam would suffer radial gate overtopping, the potential for concrete sliding failure, and the potential for erosional failure.”

Defendant argues that the doctrine of necessity, which “requires ‘an imminent danger and an actual emergency giving rise to actual necessity,’”⁵⁸ applies to plaintiffs’ case. (quoting TrinCo Inv. Co. v. United States, 722 F.3d at 1378). According to defendant, when “determining whether a response is necessary, the proper focus is on whether it was reasonable under the circumstances.” (citing the decision after remand in Trin-Co Inv. Co. v. United States, 130 Fed. Cl. 592, 599-600 (2017)). Defendant further argues that “‘the necessity of an “actually necessary” [sic] response[] must be measured *at the time of the actual emergency and imminent danger*, not in hindsight,” (emphasis in original; first alteration added) (quoting Trin-Co Inv. Co. v. United States, 130 Fed. Cl. at 601 (quoting Brewer v. State, 341 P.3d 1107, 1118 (Alaska 2014))), and defendant argues that “this assessment must consider the information available at the time.”

Defendant, quoting the trial testimony of Paula O’Brien, emphasizes that Lake Estes is “a ‘sensitive reservoir’ with ‘very little storage’ that is ‘very reactive to inflows,’” and that “Lake Estes rose to within mere inches of the top of the operational pool by the evening of September 12,” after “the Bureau had been facing a steadily increasing elevation level for twenty-four hours despite its releases,” while “estimated inflow was increasing by 1,000 cfs hour over hour—threatening to engulf the buffer space and overtop the radial gates.” Moreover, defendant argues that “[w]hile Bureau employees

⁵⁸ Defendant previously asserted that the police powers doctrine also applies in the above captioned case as a defense to the government’s liability. Defendant refers to the police powers defense only in a footnote to the necessity defense in its trial brief, however, arguing that “[b]ecause the United States acted reasonably when faced with an unavoidable choice involving health, safety, and public welfare, its actions are similarly insulated from takings liability.” (alteration added). Plaintiffs opposed defendant’s assertion of the police powers defense on the grounds that the

decisions by the Bureau, the same ones that ultimately caused the taking, created the purported emergency the United States now seeks to use to invoke as the impetus for its police powers defense. The Court should reject that defense since a party cannot manufacture an emergency and then use it as an excuse for its unlawful acts to correct the emergency it created.

(citing In re Upstream Addicks & Barker (Texas) Flood-Control Reservoirs, 146 Fed. Cl. at 263-64). Defendant’s police powers defense, however, was not fully developed by the parties and is not necessary to the court’s decision in the above captioned case, in which the court has found causation of the damage to plaintiffs’ property is not attributable to the defendant and that no taking occurred in the above captioned case.

have said that Olympus Dam was safe during the storm, those comments do not diminish the imminent danger. Defendant argues that Bureau employees believed Olympus Dam was not in danger of breaching or failing *because* of the Bureau's operations," (alteration added), and defendant cites the testimonies of Bureau of Reclamation employees James VanShaar, Ralph Beall, and Paula O'Brien, all of whom testified that the Bureau of Reclamation employees' actions during the September 2013 storm prevented Olympus Dam from being in danger or damaged. Defendant claims that "the Bureau's success in averting dam failure does not negate the imminent danger."

Defendant also argues "that the September 2013 storm created an actual emergency," recognized when "the state of Colorado, the federal government, and the city of Loveland all declared the storm an emergency before inflow to Lake Estes or its elevation level had even peaked," and when "[t]he Bureau formed an Incident Management Team during the storm, which it uses to manage '*emergencies* at Olympus Dam.'" (emphasis in original; alteration added). Defendant states that the September 2013 storm had an "annual exceedance probability" of "as low as 0.1%," or "a 1,000-year storm event," in which, during a twenty-four-hour period, "Estes Park received more than double its September monthly average rainfall."⁵⁹

According to defendant, "the Bureau's actions in releasing water from Olympus Dam were reasonably necessary because of the increasing elevation of Lake Estes and the ongoing severe nature of the storm." Defendant asserts that plaintiffs cannot rely on "the benefit of hindsight" to argue over "what the Bureau could or should have done," but instead contends that with the information the Bureau had, indicating that "the Bureau projected the storm to continue, with estimates of inflow increasing by 1,000 cfs hour over hour," the court should find that "the Bureau's actions were reasonably necessary in response to the imminent danger of dam failure and the actual emergency of the 1,000-year storm event." Defendant distinguishes the above captioned case from the Upstream Addicks case decided by a Judge of the Court of Federal Claims.⁶⁰ Defendant argues that "the Bureau did not design Olympus Dam to impound water on Plaintiffs' properties," and the government did not cause the flooding of plaintiffs' properties "as 'the direct result of calculated planning.'" (citing In re Upstream Addicks & Barker (Texas) Flood-Control Reservoirs, 146 Fed. Cl. at 264). Defendant instead characterizes the flooding as "just an incidental effect" of responding to the emergency.

⁵⁹ Defendant cites to the rainfall "[f]rom the early morning of September 12 through the early morning of September 13—a period that include peak inflow at Lake Estes," although defendant does not state the amount of rainfall that fell during that twenty-four-hour period. Defendant also claims that Estes Park "received 11.54 inches of rain between September 9 and September 16."

⁶⁰ Defendant also cites to In re Downstream Addicks and Barker (Texas) Flood-Control Reservoirs, 147 Fed. Cl. 566, 575-76 (2020), to support its argument, however, the Downstream Addicks decision was reversed and remanded by the Federal Circuit in Milton v. United States, 36 F.4th at 1163, after all submissions by the parties were completed in the case currently before this court.

As noted above, defendant's witness Dr. Bowles considered three hypothetical scenarios in which water releases from the Olympus Dam remained static throughout the September 2013 storm. Dr. Bowles calculated, for each hypothetical, the duration of time that different portions of the Olympus Dam would have been overtopped or damaged. Plaintiffs, however, argue that defendant's expert witness Dr. Bowles' conclusion that Olympus Dam was in danger during the September 2013 storm is not credible. Plaintiffs argue that Bureau of Reclamation personnel Howard Bailey and Paula O'Brien testified "that Olympus Dam was never in danger of failing or breaching" during the storm. Plaintiffs quote extensively from the testimonies of these witnesses, including Mr. Bailey's statement, when asked how he knew that "Olympus Dam was not in danger:"

I know this because we had people on site at the dam and because I was attending all the Incident Management Team meetings and other reoccurring meetings where we were receiving feedback from the people on site. And at no point was there any failure or breach suggested. We were constantly concerned with the safety of the dam. And in the extensive onsite monitoring that was being done, the team was consistently assured that the dam was not at risk of failing.

As quoted by plaintiffs, Ms. O'Brien's testimony differentiated the "long-term risk" of Olympus Dam overtopping if releases were not made, from the lack of "active present tense" danger of Olympus Dam failing during the September 2013 storm.

Plaintiffs argue that defendant's expert Dr. Bowles did not consider the Olympus Dam Emergency Action Plan in formulating his hypothetical scenarios of dam failure, nor did Dr. Bowles consider "maintaining an elevation below 7474 feet and then following the Emergency Action Plan or restricting releases to less than 1500 cfs" in his hypothetical scenarios. Plaintiffs state that "Dr. Bowles admitted on cross-examination that his hypothetical scenarios could never have occurred if the elevation of Lake Estes never exceeded 7475 feet," the overtopping height of Olympus Dam's spillway gates when closed. Plaintiffs argue that "the elevation of Lake Estes never even reached (let alone exceeded) 7474 feet" during the September 2013 storm. Plaintiffs further argue that Dr. Bowles' hypothetical scenarios of the dangers of exceeding 7,475 feet elevation in Lake Estes are inconsistent with the historic "first fill" of Olympus Dam, which the Bureau's Post Incident Analysis Report records as 7,475.25 feet. For these reasons, plaintiffs argue that defendant's expert Dr. Bowles' opinions on the safety of Olympus Dam are not credible.

Additionally, plaintiffs argue that defendant's necessity defense fails because "the government is responsible for creating the emergency," and the government knew that "flooding beyond the extent of government-owned land upstream would result, in light of the design of the dams and the plans for their operation." (quoting In re Upstream Addicks & Barker (Texas) Flood-Control Reservoirs, 146 Fed. Cl. at 264). Plaintiffs argue in their reply brief that the Bureau's decisions, including, according to plaintiffs, "releasing more water than necessary in order to draw down the elevation of Lake Estes," and "shutting down the Olympus Tunnel," "were made to protect government properties in the C-BT," and that the Bureau made those decisions "knowing its releases would inundate properties downstream." Therefore, according to plaintiffs, "the necessity defense cannot

apply here, because it cannot be said that “necessity” existed in this case, when the flooding that occurred was the direct result of calculated planning,” as well as “the Bureau’s decisions in running its C-BT facilities during the 2013 storm.” (quoting In re Upstream Addicks & Barker (Texas) Flood-Control Reservoirs, 146 Fed. Cl. at 264).

As the United States Court of Appeals for the Federal Circuit explained the necessity doctrine in TrinCo Investment Co. v. United States,

the United States Supreme Court has observed that the “common law ha[s] long recognized that in times of imminent peril—such as when fire threatened a whole community—the sovereign could, with immunity, destroy the property of a few that the property of the many and the lives of many more could be saved.”

TrinCo Inv. Co. v. United States, 722 F.3d at 1377 (alteration in original) (quoting United States v. Caltex, 344 U.S. 149, 154 (1952)). The necessity doctrine absolves the government of liability for the property it destroys in responding to the emergency. See id. (quoting Lucas v. S.C. Coastal Council, 505 U.S. 1003, 1029 n.16 (1992)). Moreover, the Federal Circuit has stated that “the doctrine of necessity may be applied only when there is an imminent danger and an actual emergency giving rise to actual necessity.” Id. (citing United States v. Caltex, 344 U.S. at 151-56; Ralli v. Troop, 157 U.S. 386, 405 (1895); Bowditch v. City of Boston, 101 U.S. (11 Otto) 16, 16-19 (1879); Mitchell v. Harmony, 54 U.S. (13 How.) 115, 135 (1851)). The Judge of the Court of Federal Claims in Upstream Addicks restated the rule from TrinCo as: “Three requirements must be met for the necessity doctrine to apply: (1) ‘actual emergency;’ (2) ‘imminent danger;’ and (3) ‘actual necessity of the [g]overnment action.’” In re Upstream Addicks & Barker (Texas) Flood-Control Reservoirs, 146 Fed. Cl. at 264 (alteration in original) (quoting TrinCo Inv. Co. v. United States, 722 F.3d at 1379). The Upstream Addicks court, moreover, acknowledged limits on the necessity doctrine:

Where, as here, the government is responsible for creating the emergency, granting the government immunity from liability under the necessity doctrine would “stretch[] the doctrine too far.” [TrinCo Inv. Co. v. United States, 722 F.3d at 1378]. Further, the term “emergency,” according to both common usage and definition, refers to “a state of things *unexpectedly arising*.” *Emergency*, *Oxford English Dictionary*, <https://www.oed.com/view/Entry/61130?redirectedFrom=emergency#eid> (last visited Dec. 17, 2019) (emphasis added).

In re Upstream Addicks & Barker (Texas) Flood-Control Reservoirs, 146 Fed. Cl. at 264 (emphasis and first alteration in original). The Judge in Upstream Addicks refused to apply the necessity defense based on these limitations, because “the Corps knew that when a severe storm like Harvey came, flooding beyond the extent of government-owned land upstream,” and because the government created the emergency when it “made a calculated decision years before Harvey, when it designed, modified, and maintained the dams in such a way that would flood private properties during severe storms.” Id. at 263-64.

As discussed above, the evidence in the record before this court in plaintiffs' case indicates that September 2013 flood was the first significant flood since 1976 in the Big Thompson River Canyon. Plaintiffs testified that on the morning of September 12, 2013, they received automated "reverse 911" calls to their homes advising them to evacuate. By the time of the "reverse 911" calls, the Bureau personnel at Olympus Dam and the East Colorado Area Office had already begun to activate their emergency response procedures, such as the activation of the Incident Management Team in the early morning hours of September 12, 2013, and the initiation of emergency alerts up to Response Level 3, and the Bureau's response to the September 2013 flood began the night before, on September 11, 2013. Additionally, on September 12, 2013, the federal government, the State of Colorado, and the City of Loveland all declared emergencies in response to the September 2013 storms. This does not indicate a lack of responsiveness by the Bureau, but rather that the magnitude of the September 2013 storm and the flooding and consequences it could cause were unexpected from the perspectives of the federal government and the state and local officials, as well as plaintiffs. Therefore, the reasoning of the Upstream Addicks case does not control in the above captioned case because, under the definition of "emergency" utilized by the In re Upstream Addicks & Barker (Texas) Flood-Control Reservoirs Judge, the September 2013 storm in the above captioned case represented "a state of things unexpectedly arising" which Bureau personnel then took steps to address. See Emergency, Oxford English Dictionary, <https://www.oed.com/view/Entry/61130?redirectedFrom=emergency#eid> (last visited May 2, 2023); In re Upstream Addicks & Barker (Texas) Flood-Control Reservoirs, 146 Fed. Cl. at 264.

Moreover, and as discussed above, the evidence in the record before the court does not establish that the Bureau's operation of Olympus Dam caused the flooding which damaged plaintiffs' properties. Furthermore, under the standards articulated in Arkansas Game & Fish Commission v. United States, 568 U.S. 23, given the data contained in the Colorado Department of Transportation 2014 Hydrology Report, even with a bulking factor of 2.0, the largest suggested by plaintiffs' expert Mr. Brown, the peak release from Olympus Dam would have accounted for only 1,444 cfs of the peak flow in the Big Thompson River at plaintiffs' homes, out of more than 14,000 cfs. As found above, the flooding at plaintiffs' properties and throughout the Big Thompson River Canyon was not a direct product of the actions of the Bureau of Reclamation.

Federal, state, and local authorities all declared emergencies with respect to the Big Thompson River Canyon area on September 12, 2013, in response to the ongoing storm. The Bureau personnel operating Olympus Dam and the East Colorado Area Office activated their emergency procedures and formed an Incident Management Team. During the course of September 12, rainfall and runoff from the storm increased, while C-BT Project facilities such as the Pole Hill Powerplant began to suffer damages from the sudden influx of floodwaters, resulting in the Bureau personnel seeking alternate methods of moving water through the system to avoid further damage to facilities while more water continued to enter the system. Over the course of the night of September 12 into 13, 2013, water levels continued to rise in Lake Estes, ultimately coming very close to the top of the operational pool in Lake Estes at elevation 7,474 feet, as testified by Mr. Miller. It may appear, based on the understanding of certain government officials that the Olympus

Dam was not in imminent danger, which conflicted with testimony by other government officials indicating that a “danger” or “risk” was posed by the rising water elevations, and which resulted, after consideration, in a decision to effect increased water releases to avoid what they considered more catastrophic damages. The steps taken by the government officials, however, according to their own testimony, were ultimately the reason that the Olympus Dam did not fail, which was the danger that concerned them. The testimony that the dam was not in danger can also be understood as reflecting that those witnesses understood that it was their own success given that the actions they took preserved the dam, not a lack of a possibility that the dam could fail, including by Paula O’Brien’s contrast of “risk” and “danger” in her testimony. The court found the testimony from the Bureau employees who testified to the actions taken as part of the response to the September 2013 storm to be credible. The actions of the government officials and personnel on September 12 to treat the September 2013 storm as an unpredictable emergency in an extreme weather situation, especially the continuing and intensifying rainfall and runoff from the storm, leading to floodwaters which damaged C-BT Project facilities, indicate that on September 12, 2013, the storm represented an actual emergency within the meaning of the necessity doctrine. See TrinCo Inv. Co. v. United States, 722 F.3d at 1379.

Moreover, during the night of September 12 and 13, 2013, rainfall and runoff from the storm continued to enter Lake Estes at a high rate, causing the water level in Lake Estes to rise. The Bureau personnel, however, lacked a method to accurately measure the inflow in Lake Estes and outflow from Olympus Dam, as the downstream gauge had been inoperable since early in the morning of September 12, and had to rely on calculations based on Olympus Dam spillway gate openings and Lake Estes reservoir elevations. By approximately 11:30 p.m. on the night of September 12, the water elevation in Lake Estes was less than half a foot below the 7,474 feet height of the top of the operational pool, and if the water rose above the top of the operational pool, there was only one further foot of vertical space in Lake Estes before the water would overtop the closed Gate 3 on the Olympus Dam spillway. As Dr. Bowles testified, the overtopping of one or more of the spillway gates could have led to failure of the Olympus Dam and uncontrolled releases downstream into the Big Thompson River. Because the Bureau personnel found themselves with so little storage space left in the Lake Estes reservoir, while the storm continued to deposit more and more rainfall and runoff into Lake Estes, by shortly before midnight, September 12, 2013, it was reasonable to conclude that there was imminent danger to Olympus Dam within the meaning of the necessity doctrine. See TrinCo Inv. Co. v. United States, 722 F.3d at 1379.

While plaintiffs argue that the Bureau could have waited longer before it began its peak releases, increased its releases less, or could have opened Olympus Tunnel to allow more water to leave Lake Estes other than through Olympus Dam, plaintiffs’ after-the-fact arguments do not overcome the conclusions reached by the government officials at the time, including at the Olympus Dam site, to prevent more catastrophic damage and the necessity of the government’s actions. The Bureau personnel operating Olympus Dam at the time that peak releases were commenced from Olympus Dam did not have access to the calibrated models of rainfall, runoff, and other storm features of which both parties have made use in after-the-fact analyses. Rather, Bureau personnel operated

during an emergency, without the ability to know whether the inflow to Lake Estes would increase or stabilize, and, therefore, Bureau personnel could not know with precision how long it would take to overtop Gate 3 if they did not increase releases as they ultimately, after consultation and deliberation, did. Further, the Bureau had already shut down inflow into the Eastern Slope portion of the C-BT Project through the Adams Tunnel, and so the Bureau was limited as to the actions it could take to control inflow to Lake Estes as rainfall increased. Additionally, the Bureau had stopped outflows through Olympus Tunnel in order to protect the failing Pole Hill Powerplant and the Rediversion Structure, which would have been in danger if the Bureau of Reclamation had reopened the Olympus Tunnel. Therefore, the Bureau personnel were faced with decisions without a crystal ball as to future storm conditions and the potential of causing damage to failing C-BT Project facilities. The government officials chose a reasonable security option under the circumstances when they increased releases through Olympus Dam sufficient to lower the water elevation in Lake Estes and give the Bureau personnel the ability to continue managing inflows into Lake Estes for the duration of the storm. Accordingly, there was a basis at the time for the government officials to conclude that it was necessary for the Bureau to increase releases from Olympus Dam shortly before midnight on the night of September 12 and 13, 2013. Therefore, also based on the necessity doctrine, plaintiffs cannot pursue a taking of plaintiffs' properties resulting from the flooding which occurred during the September 2013 storm.

CONCLUSION

After reviewing the evidence in the record in the above captioned case, including the trial testimony, plaintiffs failed to establish that the United States caused the damage to plaintiffs' properties during the September 2013 storm or that even if causation could have been established by the plaintiffs, that the doctrine of necessity would not apply to defeat plaintiffs' claims. Accordingly, plaintiffs have failed to prove they have a takings claim under the Fifth Amendment to the United States Constitution. The Clerk of the Court shall enter **JUDGMENT** in favor of defendant.

IT IS SO ORDERED.

s/Marian Blank Horn
MARIAN BLANK HORN
 Judge